OCTOBER 1951

INDUSTRY AND POWER

For Executives and Engineers Responsible For Engineered Plant Services

Featuring:

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Synchrotie Drives in Process Industries ..... Page 85
Modern Fuel Oils and the Application of Additives ..... Page 92

POWERFUL Fans and Blowers...

AND Your Hartzell Field Office PUTS HARTZELL ENGINEERING RIGHT IN YOUR BACK YARD!

If you've got an "incurable" air-moving problem, dump it in our lap. It's for just such service that we have built our engineering-distribution system. Each of our field offices—and there's one near you—is there to *help you get results,* not merely to calculate the dollars and cents of a sale.

No red tape, no waiting for home-office authority. Here's how: If you don't know your Hartzell office, drop us a line. A fully experienced direct factory representative will call on you promptly. He'll have full authority to work with you, make recommendations and quote costs. He can check with our home-office engineering laboratory if he needs to.

You can bank on what he tells you. That's why he's with Hartzell. And that's why Hartzell customers move air effectively at minimum cost.

If you foresee an air-moving problem for the future, we urge you to call your Hartzell man in now. Give us all the time you can. Within the past few months we have practically doubled plant capacity, and each month we are setting new production records, but we still haven't caught up with the demand for Hartzell products.

Why the demand? It's simple. Hartzell fans and blowers move air efficiently.

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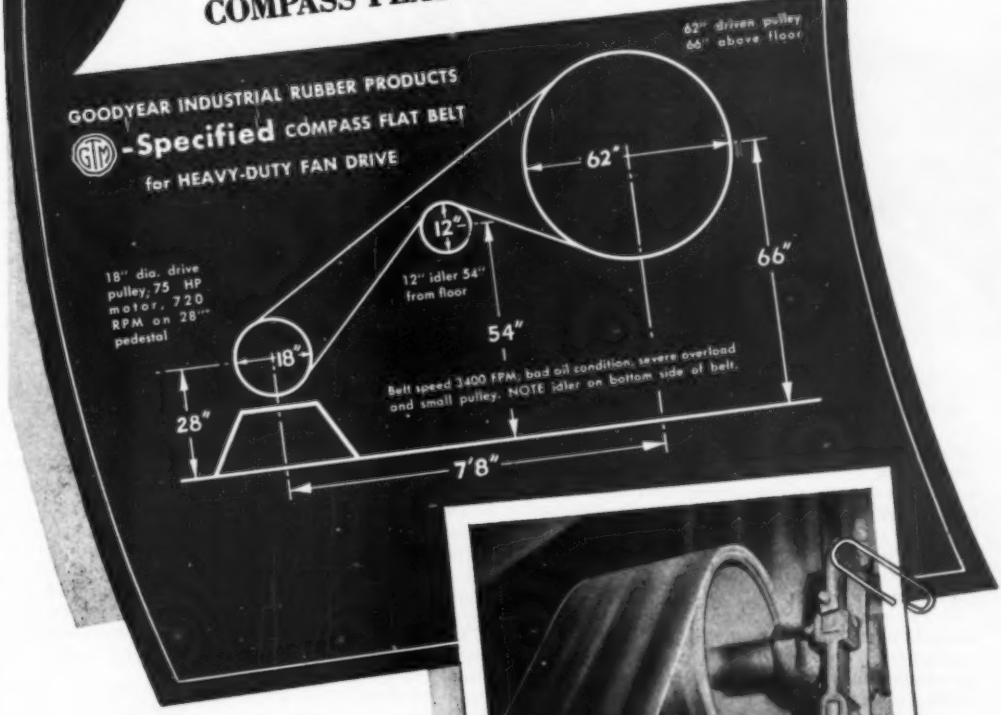
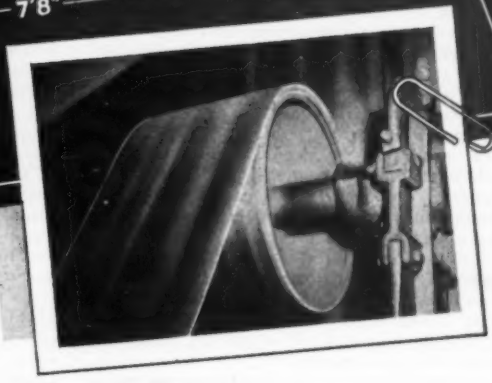
PROPELLER-TYPE FANS AND BLOWERS—ROOF VENTILATORS—UNIT HEATERS • ENGINEERING OFFICES IN PRINCIPAL CITIES

8 TIMES THE SERVICE

on a tough fan drive

Ordinary belt on heavy drive *lasted 6 months*
G. T. M.–Goodyear Technical Man–specified
COMPASS FLAT BELT–*running 4 years so far!*


GOODYEAR INDUSTRIAL RUBBER PRODUCTS
GTM-Specified COMPASS FLAT BELT
for HEAVY-DUTY FAN DRIVE
62" driven pulley
66" above floor
62"
12"
66"
18" dia. drive pulley; 75 HP motor, 720 RPM on 28" pedestal
12" idler 54" from floor
54"
18"
28"
Belt speed 3400 FPM, bad oil condition, severe overload and small pulley. NOTE idler on bottom side of belt.
7'8"



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GOODYEAR

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We think you'll like "THE GREATEST STORY EVER TOLD" – Every Sunday – ABC Network

Compass–T.M. The Goodyear Tire & Rubber Company, Akron, Ohio

"... involving the world's largest and most intricate air conditioning project."

The Kalamazoo, Michigan, Plant of the Upjohn Company
The Austin Company, engineers and contractors, Chicago, Ill.

Over all, constantly on duty, are the super-human "brains" of another Johnson System of automatic temperature and humidity control. Like all Johnson Systems, the installation at Upjohn's was designed especially to solve the precise requirements of the industry which it serves. Such flexibility assures just the right results, regardless of the unusual applications which are encountered.

In the thoroughly modern Upjohn plant, the adaptability of Johnson equipment is demonstrated conclusively. There are 126 separate year-round air conditioning systems, with central heating and cooling coils, and at each the temperature of the air delivered to eight or more branch reheaters is controlled by Johnson instruments commanding Johnson valves and dampers. The characteristic Johnson "Master-Submaster" principle is employed in controlling Johnson valves on the reheaters. Submaster room thermostats for each area are reset, in accordance with outdoor temperature, to maintain exactly the required condition.

In addition to the comprehensive air conditioning equipment, 10 heating systems for smaller areas, 27 sets of convertors and 108 exhaust systems also are Johnson-controlled. In the truss spaces, 52 unit heaters are operated by Johnson thermostats and dampers, to prevent roof losses. Various special-purpose systems, for snow melting, office heating, hot water circulation in the warehouse, produce proper temperatures at the command of Johnson controllers which operate Johnson valves and dampers.

"Comfort" air, "process" air and critical humidity requirements present varied problems at the Upjohn plant. The proper solution of those problems is a part of the Johnson planned-for-the-purpose, installed-for-the-purpose policy. Whatever your problem may be, ask a Johnson engineer from a nearby branch office. JOHNSON SERVICE COMPANY, Milwaukee 2, Wisconsin. Direct Branch Offices in Principal Cities.

Johnson T-800-A
Capillary Thermostat

JOHNSON *Automatic Temperature and Air Conditioning* **CONTROL**

DESIGN • MANUFACTURE • INSTALLATION • SINCE 1885

Edited specifically for executives and engineers responsible for the selection, installation, operation & maintenance of equipment required for Engineered Plant Services*

INDUSTRY AND POWER

The Magazine for Engineered Plant Services

INDUSTRY AND POWER

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***Engineered Plant Services**

By ***Engineered Plant Services*** we mean the ***providing*** or ***generating, transmitting, controlling, applying,*** and ***maintaining*** of POWER, STEAM, MECHANICAL DRIVES, HEAT, ELECTRICITY, AIR, WATER, and other engineered services in and for all areas of the industrial establishment as required for production and operation. This includes Lubrication, Piping Systems, Industrial Waste Disposal, Corrosion Control, Electrical Systems, Industrial Heat, Coal and Bulk Handling, Dust and Fume Control, and other related services of an engineering nature.

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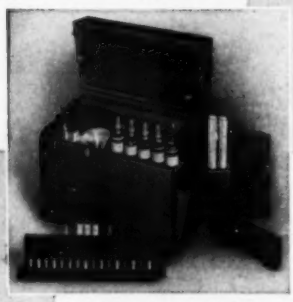
Only Taylor Comparators give PERMANENTLY GUARANTEED COLOR STANDARDS for Testing pH, Phosphate



Simply place reagent treated sample in middle tube in base, move the color standard slide until colors match and . . .

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There's no danger of mechanical inaccuracy when you use a Taylor Comparator for determining pH or phosphate in boiler water . . . because *all Taylor liquid color standards carry an unlimited guarantee against fading.*

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Write direct for your free copy of "Modern pH and Chlorine Control" If this valuable reference is not already in your library. Gives theory and practice of modern boiler water testing, describes and illustrates Taylor equipment.

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Acorns of science

Developments not yet available, but of interest to those responsible for Engineered Plant Services

Fast Crystal Clutch

Taking a place with eddy current and magnetic particle types, another electrically controlled unit, a fast acting crystal clutch, has been developed for applications in high speed computers. Energizing elements are three bimorph piezo-electric crystals. A d-c voltage applied to the electrodes of the crystals causes them to bend, pressing the clutch output disk against the rotating input disk. In the experimental model, useful torque delivered by the output shaft was about 16.5 oz-in. at 400 v and 21 oz-in. at 500 v within 0.2 millisecond after voltage was applied.

Corrosion Protection for Pipes

Developments by manufacturers of plastic coatings, working with petroleum technicians on the problem of corrosion in oil well tubing, promise better protection in many types of equipment. Ordinary pipe and pipe coated with a vinyl plastic were subjected to a five month test in which they carried a daily flow of 100 bbl of oil and 5000 bbl of iodized salt water. Preliminary results showed the ordinary pipe to be corroded deeply while that coated with the plastic was unaffected.

Plastic Forming Process

Applications of plastics are frequently limited by possible manufacturing methods. Du Pont chemists have now made public information on dispersions of "Teflon" resins in water, permitting new methods for the polymer which has hitherto been limited to molding, extrusion and a process for coating wire by rolling on and sintering the powdered plastic. Among uses for aqueous dispersions are casting of films and coatings for materials such as glass cloth, making it a substitute for mica in many cases.

Preparation of homogenous, nearly transparent films involves four distinct steps: casting, drying, baking above 327 C and cooling. Thickness of films cast is limited by cracking during baking, heavier films are cast in multiple layers. Cooling is fast for toughness or slow to give better wetting for succeeding layers. Aqueous dispersions may also be extruded as tapes and wire coatings when mixed with suitable lubricants.

Better Gasoline

A new refining process, said to be the worlds first fluid hydroformer, is being perfected by refinery and chemical engineers. By the process, 55 octane gasolines can be converted into very high octane aviation gasoline. This may be a solution to refiners' efforts to develop methods of upgrading low octane products, making a wider range of fuels more available at lower cost.

Airless Paint Spray

Instead of the familiar use of compressed air to break fluid paint into finely divided particles for spraying, a new method employs a spinning cone in an electrostatic field for atomization. Paint is pumped at a metered rate to the cone rotating at high speed in an intense, high potential electrostatic field that pulls very small, charged particles to the work. From 200,000 to 300,000 atomized paint particles per second leave the head and, under the influence of the field, 95 to 99 per cent of the volume is deposited. Expense of water washed walls and paint lost on them is eliminated.

Photos Courtesy The Austin Company
Engineers and Builders

4 UNION BOILERS *at* THE UPJOHN COMPANY

Fine Pharmaceuticals Since 1886

KALAMAZOO 99, MICHIGAN

EACH of these 4 coal fired Union "A" Type Boilers delivers 60,000 lbs. of steam per hour 175 psi—sat., for heat and process requirements at the new Upjohn Plant on Portage Road, Kalamazoo, Michigan. Their design provides for gas or oil firing if necessary. The Upjohn selection charges these Union Boilers with supplying steam for some 33 acres of modern plant under roof, where over 700 world-famous Upjohn pharmaceuticals are produced. Known for fine pharmaceuticals since 1886, Upjohn selects every unit upon which production depends with critical eyes. You can fully depend upon Union to furnish correct steam generating units for your specific requirements. You will profit by consulting with Union engineers.

The Upjohn boiler plant building is designed to accomodate 2 more boilers when needed. The 50 ton per hour coal bunker overhead is designed with weigh-larry to serve boilers on both sides of the boiler room.

UNION IRON WORKS . . . *Since 1890*

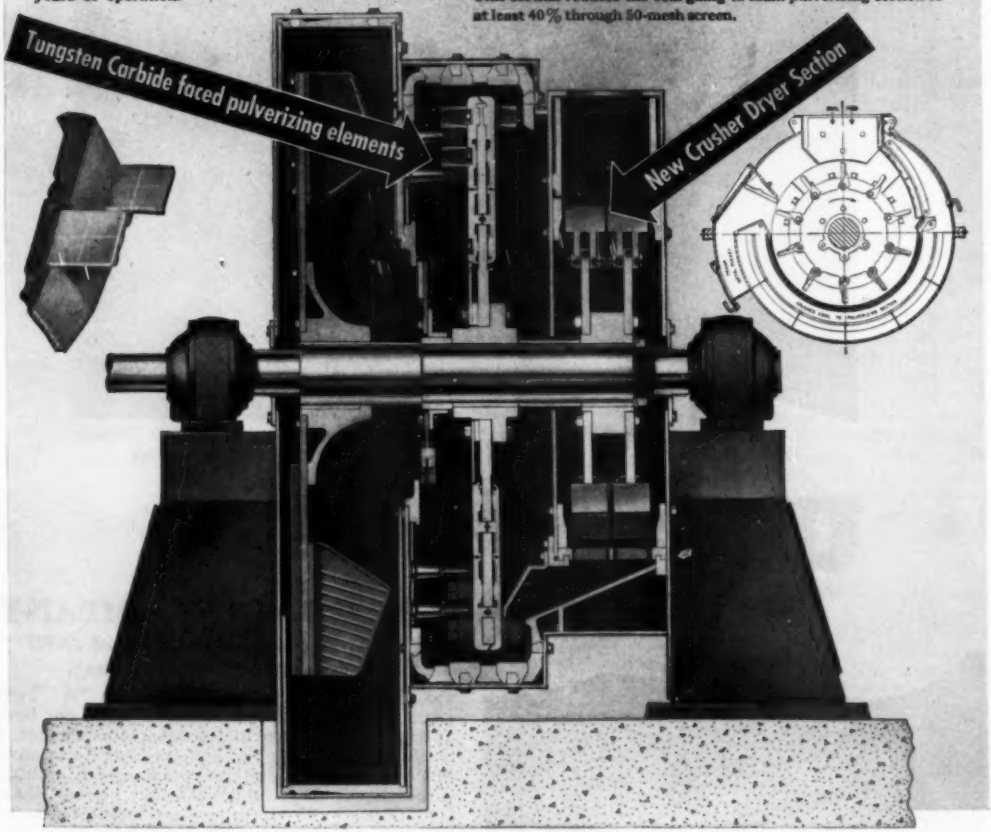
373 CASCADE STREET • ERIE, PENNA.

BOILERS • PROCESS EQUIPMENT • FABRICATED STEEL

The New "RILEY 50" Pulverizer

Gives long uninterrupted operation, low maintenance and sustained fineness over years of operation.

Where the free moisture is evaporated—no capacity reduction with high moisture—where foreign materials in coal are rejected. This section reduces the coal going to main pulverizing section to at least 40% through 50-mesh screen.



We can merely touch on the many operating advantages of the new Riley "50" pulverizer in a two-page ad. The Riley "50" is the most significant pulverizer development in the past decade. Write for the story of the Riley "50." It will pay you to thoroughly investigate the Riley "50" before purchasing coal pulverizers.

TRADE MARK Rx REGISTERED

RILEY

STOKER CORPORATION, WORCESTER, MASS.

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BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • FLUE GAS SCRUBBERS

Spontaneously Accepted by Engineers

Because of These Outstanding Features

*1 No capacity reduction with increase in moisture.

2 Tramp iron, iron pyrites and other foreign materials in coal rejected.

*3 Pulverizing elements faced with tungsten carbide.

4 Fineness sustained over years of operation.

5 Long periods of operation without necessity of shutdowns.

*6 Unusually high capacity per unit of space.

*7 Minimum foundation requirements.

*8 Ability to carry low loads.

9 Flexibility-wide load range.

*10 Operates without coal, with no noise and without wear or damage to parts.

11 Low maintenance and power.

*12 No explosion hazard, travel of coal through pulverizer faster than flame propagation.

*13 Quiet vibrationless operation.

*14 Ease of lighting and regulation.

15 High primary air temperatures.

16 Thoroughly dependable.

*17 Negligible cost of lubrication.

*18 All moving parts on a single horizontal shaft with bearings outside of housing. No worms or gears.

*19 Primary air fan integral with pulverizer —separate fan and motor not required.

No other pulverizer can approach the Riley "50" in these important characteristics.

All of these companies have ordered Riley "50" Series pulverizers within the past year

Public Utilities

*Monongahela Power Co.
*Iowa Electric Light & Power Co.
Utah Power & Light Co.
*Northern States Power Co.
*The Potomac Edison Co.
*Superior Water, Light & Power Co.
Central Ohio Light & Power Co.
*City of Owensboro, Ky.
City of Austin, Minn.
*Corn Belt Power Co-operative
*Public Service Co. of Colorado
Hartford Electric Light Co.

Industrial Plants

St. Croix Paper Co.
Hooker Electrochemical Co.
*Pittsburgh Plate Glass Co.
Celanese Corp. of America
United States Steel Co.
*Western Electric Co.
*Continental Can Co.
Monsanto Chemical Co.
Northern Paper Mills
Bell Aircraft Corp.
Syracuse University
Riegel Textile Corp.
Owens Corning Fiberglas Co.
*U.S. Finishing Co.
*Ciba States, Ltd.
*East Newark Realty
Lawless Brothers Paper Co.

These companies have never previously used Riley pulverizers. The other companies have repeatedly ordered Riley pulverizers.

These contracts were engineered by the following consultants

Bechtel Corporation
Ebasco Services
Chas. T. Main, Inc.
Pioneer Service & Engineering Co.
Sargent & Lundy
Sanderson & Porter
Stone & Webster Engineering Corp.
Black & Veatch
United Engineers & Constructors
Stanley Engineering Co.
Kenneth R. Warrington
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Francisco & Jacobus
Douglas M. McBean
Robson & Worse, Inc.

A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

COMPLETE STEAM GENERATING UNITS

. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

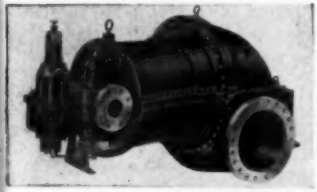
New equipment and developments

Here are the highlights of New Equipment and Development items announced by leading manufacturers, briefed for your convenience

See Readers Service Card Page 132

1—200 TO 5000 HP TURBINE LINE

A line of multi-stage, mechanical-drive turbines in ratings from 200 to 5000 hp has been announced by General Electric's Turbine Dept. Designated as types DP, DR, DRV, and DRVX, these units have been designed to cover a wide range of industrial applications, as well as for power-generation purposes. Type DP multi-stage turbine, rated from 200 to 3000 hp, is designed for

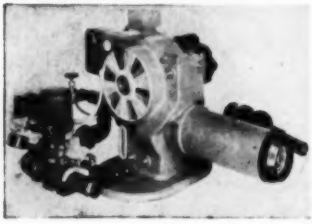


driving pumps, compressors, fans, blowers and similar equipment. It is equipped with a hydraulic governor, which provides a 30 per cent speed range and 6 per cent speed regulation. Type DR turbine, rated from 200 to 5000 hp, is built for applications requiring wider speed range, greater accuracy of control, and greater capacity than can be obtained from the Type DP turbine. Type DRV, rated from 200 to 5000 hp, has the governing characteristics of the DR multi-stage turbine, but whereas the DR unit employs a single governor controlled valve, the DRV utilizes automatic sectional valves linked to the oil relay governor.

Casing construction on all three multi-stage turbines is similar. From two to ten stages may by used, depending on the steam conditions, application and efficiency.

2—BURNER OPERATED WITH GAS OR OIL

Cleaver-Brooks Co., manufacturer of equipment for the utilization and generation of heat, has solved the problem of interruptable gas service with the introduction of its line of five "Hev-E" combination oil and gas burners. Advantages include a forced air draft system, which provides a single blower fan for combustion air, assuring perfect control to the fire under all atmospheric



conditions. Both gas and air are accurately controlled to give high CO_2 with the greatest efficiency. And both oil and gas are burned efficiently. The unit can be regulated to burn the proper amount of gas or oil for the requirements of the particluar installation. Low-fire start is accomplished with either gas or oil. Most modern electronic controls are used to guarantee that the main gas valve cannot be opened unless a pilot flame is established. Models range from 720,000 to 8,700,000 Btu when burning gas.

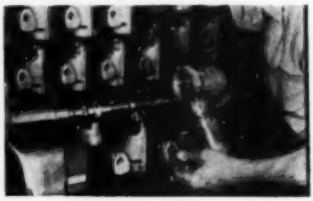
3—ARC DRIVE CONTROL FOR RECTIFIER WELDERS

An arc drive control to produce electrical transient characteristics desirable for certain welding operations now is available on Type RA selenium rectifier welders, manufactured by Westinghouse Electric

Corp. The operator can adjust the arc characteristic of the welder to suit a particular job. Device operates automatically and instantaneously to provide an extra surge of welding current at the moment the arc becomes shorted, either by contact between the electrode and the work or by a globule of molten metal bridging the arc gap. This extra surge of current helps clear the arc path and prevents arc outage or sticking of the electrode. Violent and prolonged overshoots and undershoots of welding current, characteristic of rotating types of welding generators, are eliminated.

4—STEEL INSERTS STRENGTHEN THREADS

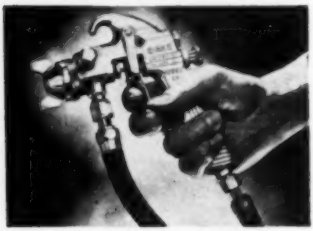
Stainless steel helical-wound wire thread-inserts are installed in tapped holes of Ingersoll-Rand's "Impactool" that is widely used for nut running, drilling, stud driving and masonry drilling. Steel bolts are used to join the housing sections. If these bolts were screwed directly into the tapped aluminum holes, seizing and galling might occur during assembly. Furthermore, threads would be subject to damage by tool vibration during operation, and the soft threads in the housing would wear when the tool is dis-as-



sembled periodically for maintenance and repair. Installation of the stainless steel Heli-Coil "liners" provides strong permanent threads, which eliminate seizing, galling and wear.

5—LIGHTWEIGHT GUN SPRAYS MANY FINISHES

The Binks Mfg. Co. has developed a new type of lightweight spray gun known as Binks Model 29 spray gun. The gun has an aluminum body casting, a cartridge-type air



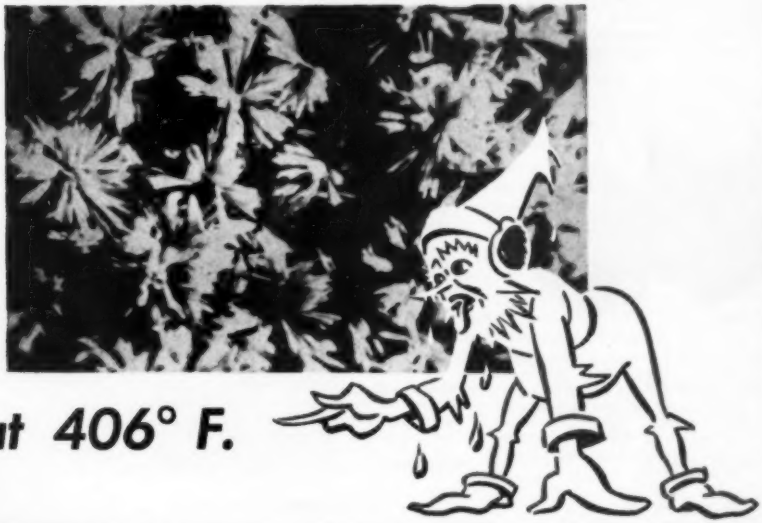
valve, a brass and steel material passage and large air passages. It can be used to spray lacquers, synthetic enamels, paints and all other finishes and coatings of light or medium viscosity. It is recommended for production-line, touch-up or maintenance painting.

6—HIGH TEMPERATURE WIRE INSULATION

Johns-Manville is now offering "Quinterra Type 3", an asbestos-base, silicone-treated, high temperature electrical insulation for service at a temperature of 180 C. Silicone-treated it is used for both interlayer and wire wrapping insulation and is adaptable to a wide range of electrical devices including air cooled, inert gas and silicone filled transformers. Some of the advantages are savings on materials, a greater

(Continued on page 12)

JACK FROST



at 406° F.

MAGNIFIED fifty times, the calcium carbonate scale in the photo above might easily be mistaken for a frosted window pane. It was formed at 250 p.s.i. in one of the Nalco Laboratories' test boilers as a part of the continuing Nalco research program, aimed at keeping such scales *out* of your power plant equipment.

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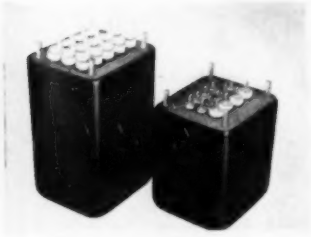
THE Nalco SYSTEM...Serving Industry through Practical Applied Science

New equipment and developments

(Continued from page 10)

factor of safety and the opportunity for more compact design. A dielectric strength of at least 350 is maintained under continuous exposure to Class H maximum temperature of 180 C. Furthermore, this dielectric strength remains practically constant even under continuously high humidity because



of high moisture resistance. Supplied in the form of sheets, rolls and tapes. Widths can vary from 1/4 to 36 in. and will be factory cut to specifications. Available thicknesses are from 3 to 9 mils. This insulation may be used alone, or it may be successfully combined with other dielectric materials such as mica or glass cloth.

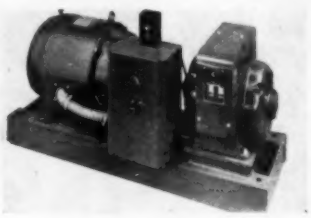
7—UNIT PROVIDES CLEAN, DRY AIR

The Model B Condensifilter, a device that removes water, oil, sludge and other foreign materials from compressed air, is a development of Hankison Corp. It combines into a single unit a dehydrating service, mechanical filter and a self-purging trap. The unit provides dry, clean compressed air for operating instruments. Measuring 15 in. high by 9 in. in dia., it has a capacity of 30 cfm at 100 psi. In operation air is admitted through the side, directed through the condensing section where it is dehydrated, and then passed through the

mechanical filter. Total drop in pressure is less than 2 psi at 100 psi working pressure. The condensing unit is composed of a series of copper coils through which cold water flows. The filtering unit is made of five hexagonal filter chambers in parallel, each chamber wrapped with seven layers of Canton flannel. Easily removed, it provides over four sq ft of filtering area and removes pieces as small as 1.0 to 2.0 microns.

8—M-G SET CONVERTS TO HIGH CYCLE

Used to convert 60 cycle current to 180 and 360 cycle frequencies is a new monocoil high frequency motor generator set built by Electric Machinery Mfg. Co. This equipment finds its greatest use in plants using high-cycle automatic electric hand

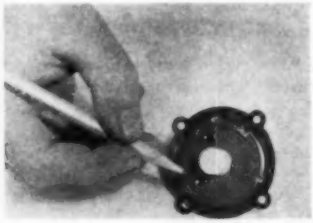


tools such as grinders and buffers. The sets are self exciting and have built-in voltage regulation that automatically compensates for fluctuations in voltage to the load. The unit shown is 6 kw, 360 cycles, 3600 rpm, with other ratings and speeds available.

Additional information on new equipment and development items is available. Use card inserted between pages 132 & 133

9—THERMOSTAT CONTROLS PLASTIC COATED

Bases for "Klixon" Thermo-Snap controls are being molded of G-E mycalex by the Plastics Dept of General Electric's Chemical Div. to assure satisfactory performance in a variety of applications requiring non-adjustable temperature controls. "Klixon" controls are manufactured by the Spencer Thermostat Co. G-E mycalex, a stone-like



insulating material composed of a special glass and powdered mica, was specified for the thermostat base because of its high-temperature resistance (up to 700 F) and high dielectric strength. By utilizing recently-perfected transfer molding techniques, metal inserts are molded in and the high-dimensional stability of G-E mycalex facilitates precision assembly of male contact points after molding. Recommended for applications that expose a thermostat to dirt, dust, lint, oil and high temperatures.

10—MACHINISTS' VISE HAS SAFETY VALVE

A 4 in. jaw fast-operating hydraulic machinists' vise is announced by the Columbian Vise & Mfg. Co. Known as No. 1004, the vise is substantially heavier than previous models and possesses higher and wider jaws. Maximum hydraulic pressure is 7000 psi and maximum jaw pressure is 4000 psi.

A safety valve protects against overloading. Vise closing speed is 7/8 in. per pump stroke, and full vise opening can be accomplished in 3 sec. The vise is controlled by 2 foot pedals, one for power and the other for release. Stop control is adjustable so that any production work is gripped and held with a single power stroke.

11—ALL-PURPOSE LUBRICANTS

An all-purpose lubricant of the Bentone type, known as "Hood Multiplex Lubricant", has been developed and placed on the market by Hood Multiplex Co., manufacturers of a complete line of oils and greases for industrial use. Produced in grades from No. 00 to No. 3, the lubricants are made with a bodying agent that gives complete stability under all service and storage conditions. They have no melting point and retain their lubricity and adhesive characteristics under all temperature conditions normally encountered. While insoluble in water, they will absorb moisture when in service without losing their adhesive or lubricating qualities; therefore, they are recommended for use wherever water or moisture is a problem.

Hood Multiplex lubricants contain no metallic soaps or fatty acids and are plastic or pumpable at temperatures from -20 to

(Continued on page 16)

Flexible Element Connection

another reason

why more
DIAMOND G9B SOOT BLOWERS
are in use than any other

When tube movement relative to the boiler walls exceeds the amount that can be compensated for by supporting the blower head on springs, the Flexible Element Connection is used. It will take care of such extreme cases where movements as great as 2½" are encountered.

The Diamond Flexible Element Connection makes the element freely self-adjusting for movement of the boiler tubes—it is entirely independent of the head and the outside piping. The head is rigidly bolted to the wall box while the element moves freely with the tube bank. Coupling assembly design prevents lateral shifting of the element to the point of nozzle misalignment.

Individual G9B units can be made automatic any time after installation by simply adding a drive to existing equipment. Then, all blowers on the boiler can be made automatic sequential in operation by addition of a control panel. Write for Catalog No. 1014 for further information. 3703

DIAMOND POWER SPECIALTY CORPORATION
Lancaster, Ohio

DIAMOND SPECIALTY LIMITED • Windsor, Ontario

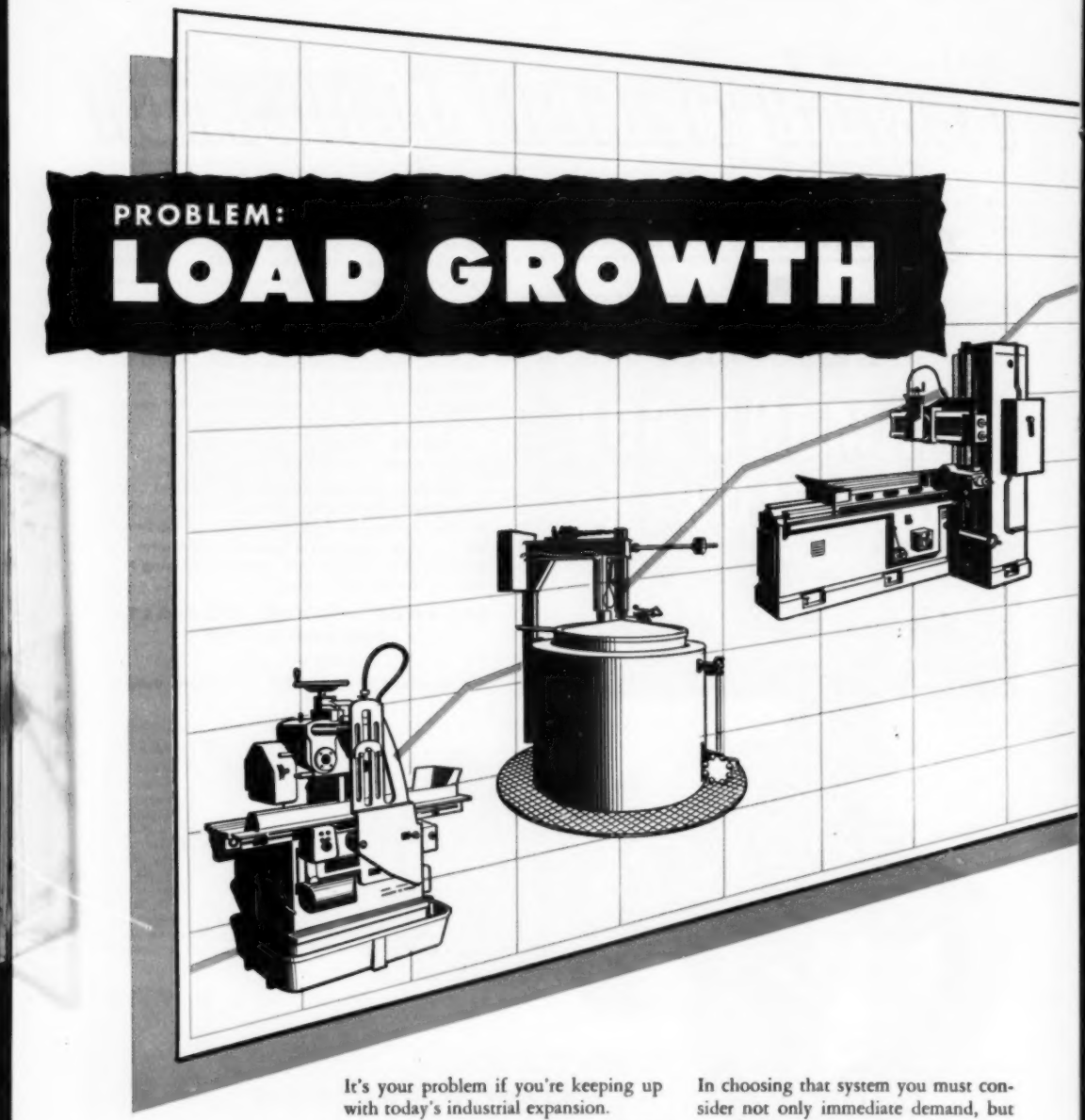
other advantages

Automatic Valved Head . . . only one operation opens and closes the valve and simultaneously rotates the element.

Adjustable Pressure Control . . . easily adjusted to reduce pressure to correct blowing needs.

Poppet Type Valve . . . proved the best type of unlubricated valve for difficult conditions.

Cam and Trigger Valve Operation—Clockwise and Counterclockwise Element Rotation.

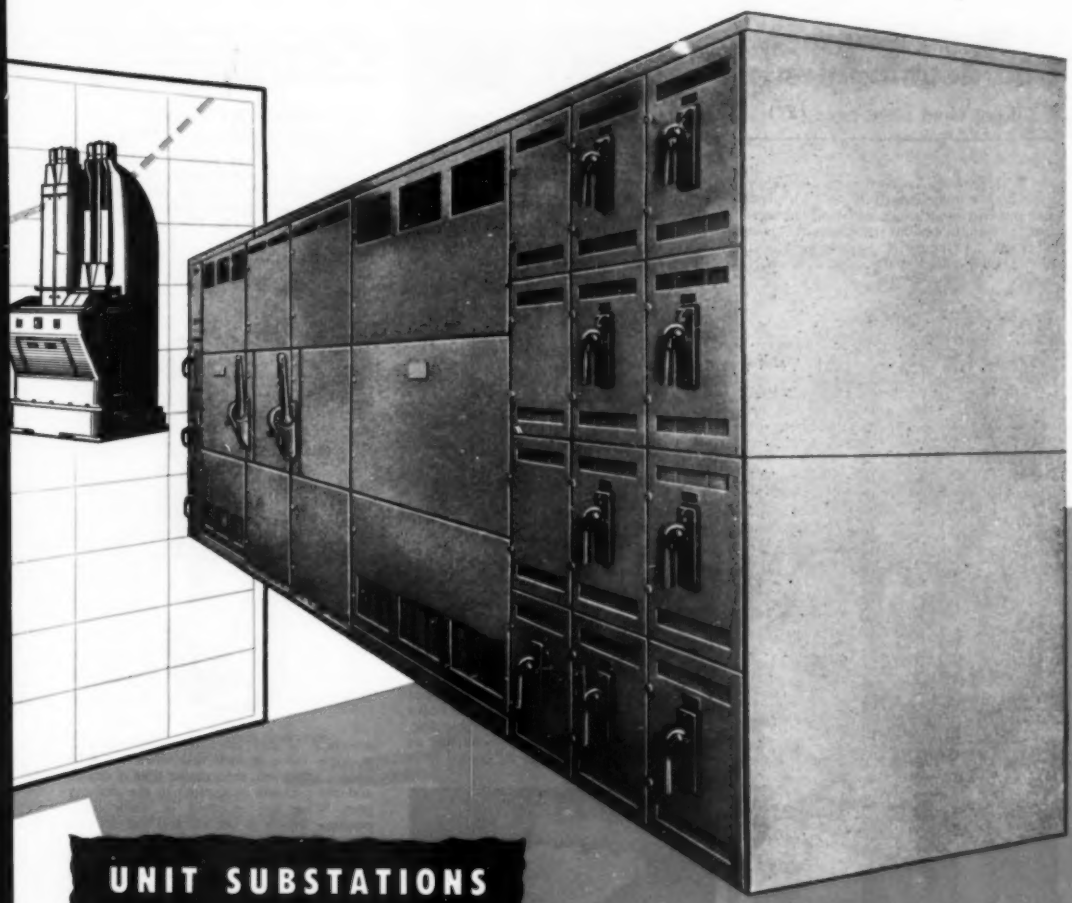


It's your problem if you're keeping up with today's industrial expansion.

And when new production machinery adds load upon load to your electrical system, your planning naturally includes installation of a unit substation system. In choosing that system you must consider not only immediate demand, but also future expansion. The system must be designed and engineered to meet your specific requirements, flexible enough to be expanded for future needs.

THE ANSWER: I-T-E UNIT SUBSTATIONS!

I-T-E Catalog 9000 describes all types of secondary unit substation equipment, offers concise, easy-to-use information on selection of distribution systems and equipment. One page alone, on cost comparison of basic power distribution systems, may save you weeks of investigation and reduce initial investment. Send for Catalog 9000. I-T-E Circuit Breaker Company, 19th and Hamilton Sts., Philadelphia 30, Pa. Subsidiaries: Railway and Industrial Engineering Co., Greensburg, Pa.; Eastern Power Devices, Ltd., Toronto.



UNIT SUBSTATIONS

Here is a typical I-T-E indoor unit substation with air cooled transformers. Substation arrangement puts primary load break interrupter switches and transformers in the center. As load grows, addition of low voltage switchgear to either end is simple and inexpensive.

Uniform appearance of the structure and symmetry of enclosing panels are consistent with the operating excellence of I-T-E switchgear.

The I-T-E Company

New equipment and developments

(Continued from page 12)

15 F depending upon the grade. They have been tested successfully on both plain and anti-friction bearings under all temperature conditions and are recommended as a lubricant for industrial equipment of all kinds, water pumps, universals, and wheel bearings.

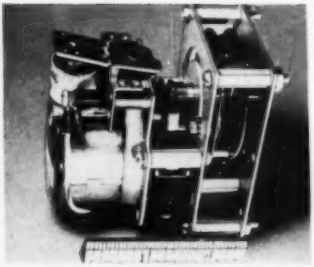
12—FILTER HANDLES HIGH PRESSURES

The Hilliard Corp. is producing Hilco high pressure oil filters for applications with pressures up to 1500 psi. Typical uses are filtering of lube and sealing oil on centrifugal gas compressors and oil pumps

on pipe lines. The oil is forced through a filter cartridge made of either fuller's earth or cellulose. Filters are available in capacities from 1 gpm to practically any flow required.

13—DELAYED ACTION RESET TIME RELAY

A. W. Haydon Co. has just entered into production on a delayed reset time delay relay that incorporates the time proven basic 6400 series d-c and 11400 series a-c time delay relay. It makes possible a delayed reset proportional to the time delay and a circuit reclosure time proportional to the length of current interruption. Reset is accurately controlled by an escapement mechanism, which adds approximately 3/4 in. to the length of the standard Haydon time delay relay. Ideally suited for application as a vacuum tube protective system. It assures the desired delay in feeding high voltage to the plate circuit, holding back



the load until the cathodes have reached proper temperature. To provide safety in the event of a power interruption it opens the circuit. Oftentimes a power interruption is of short duration. In such instances it is not desirable that the full time interval be required before reclosure of the circuit.

Additional information on new equipment and development items is available. Use card inserted between pages 132 & 133

14—PAPER WRAPPER PREVENTS RUST

Development of a heavy-duty packaging paper, treated with a volatile type rust inhibitor, is announced by the Nox-Rust Chemical Corp. This product was developed for protection of heavy machinery and bulky metal parts during storage and shipping. Called Vapor Wrapper and identified as Nox-Rust No. 12 Glas-Kraft grade, it is

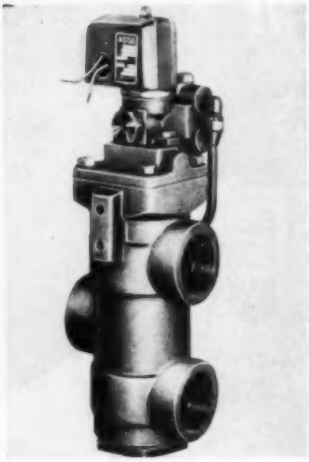
tough, resilient and tear-resistant. It is made of two high-strength kraft sheets, cemented together and reinforced with spun glass fibers. The inner ply of kraft paper is impregnated with Callex, a volatile rust-inhibitor chemical. When a metal product is wrapped or shrouded with the wrapper a vapor is released that prevents rust from forming. This product is also moisture and water repellent.

15—SEALER HOLDS UNDER PRESSURE HEAT

A compound for sealing gaskets and threaded joints of all types is announced by the Chicago Gasket Co. Called Graycote, it is composed of six basic ingredients, base of which is a spongy, metallic pigment locked in an insoluble vehicle. Retention in the non-drying vehicle keeps the compound soft, creating a permanent seal but allowing units to be easily disassembled after long periods of time even under high temperature conditions. It also lubricates threads to reduce wrench torque and allows additional takeup. This product is recommended by the maker for all oil, water, steam, gaseous fuel and refrigerant applications and is claimed ideal for sealing gasoline, distillates, LP gases and jet engine fuel. It may be used for sealing purposes in hydraulic units handling pressures up to 5000 psi.

16—THREE-WAY VALVE HAS INTERNAL PISTON

A new three-way pilot controlled valve for controlling automatically the alternate application and exhaustion of pressure to and from equipment has been developed by Automatic Switch Co. The operating char-



acteristic of this internal piston operated, packless valve is such that when the solenoid is energized, the exhaust port is closed, and the pressure is applied to the delivery port. When the solenoid is deenergized, pressure supply is cut off and the delivery port is connected to the exhaust. Under controlled timing, the cycles are repeated.

These valves are suitable for handling air, gas, oil or any other non-corrosive fluid at temperatures not exceeding 180F. Pipe sizes are 1, 1-¼, 1-½ and 2 in., each with designs suitable for 125 and 250 psi operating pressures. Standard solenoids are 115 or 230 v a-c or d-c and for 25, 30, 50 or 60 cycles, with other ratings available when required.

17—VARIABLE DRIVE CONTROLS COAL FEED

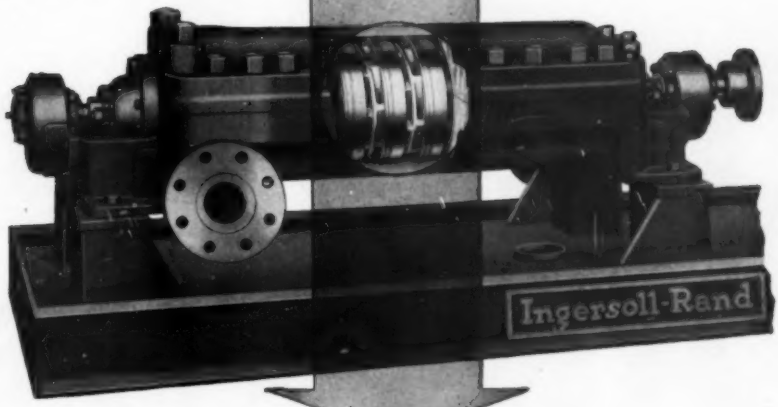
Accurate adjustment of the coal-feeding rate to the exact load demand is being achieved by Iron Fireman Mfg. Co. through its infinitely variable transmission on two

of its coal flow stoker series. An exclusive feature with its CF series coal flow stokers and PCF series Poweram coal flow stokers, the variable drive is particularly suited for use with modulating-type combustion con-

(Continued on page 20)

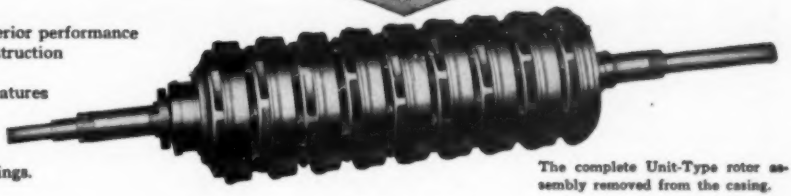
. . . here's the INSIDE STORY

on how the distinctively new HMTA can cut your high pressure pumping costs



A three-inch, nine-stage HMTA pump, with section of the casing cut away to show the rotor assembly installed.

● When it comes to superior performance and economy, it's the construction of a pump that counts. That's why the modern features of the Ingersoll-Rand Class HMTA pump mean so much to you in terms of long-range savings.



The complete Unit-Type rotor assembly removed from the casing.

SIMPLE, UNIT-TYPE ROTOR ASSEMBLY. Impellers, renewable wearing rings and stationary channel rings, containing the multiple volute fluid passages, make up the compact rotor assembly. Interstage sealing rings, compressed between the casing and channel rings, give a positive, metal-to-metal seal between successive stages. All rotor assembly elements are perfectly matched and self-aligning.

HIGH SUSTAINED EFFICIENCY. Multiple volute design, in-line staging and positive, interstage sealing contribute to the high efficiency of these units. And practical running clearances—proportioned for minimum wear—sustain this efficiency over years of service.

RUGGED CONSTRUCTION. The high-strength, symmetrical casing, is free from crossovers or cast volute passages. Complete radial and axial balance assures trouble-free operation over the complete range of pressures and capacities.

COMPACT, ACCESSIBLE DESIGN. The entire rotor assembly can be removed from or installed as a unit in the horizontally-split, smooth bore casing—without disturbing the piping. And the balancing drum, which is the only high pressure breakdown in the pump, can be inspected without opening the casing.

Ingersoll-Rand

Cameron Pump Division 590-10
11 Broadway, New York 4, N. Y.

HMTA

for pressures up to 1400 psi

Ingersoll-Rand Class HMTA pumps are available in capacities to 1600 gpm and pressures to approximately 1400 psi. For complete information on these *distinctively new* multi-stage pumps, write for your copy of Catalog 7233. Or ask your nearest Ingersoll-Rand branch office to give you the complete HMTA story.

COMPRESSORS • ROCK DRILLS
AIR TOOLS • CONDENSERS
DIESELS • GAS ENGINES
CENTRIFUGAL PUMPS

ONE VU LEADS TO ANOTHER!

When VU Boilers were first put on the market, *all* of them, quite naturally, had to be *sold*. Now a very substantial percentage are *bought*. Bought by companies that know by their own first-hand experience what they can expect in day-in and day-out performance—for example:

A paper company some years ago, in urgent need of more capacity, purchased a VU Unit. It went on the line, and—under wartime demand—*stayed there* for 432 days without a shutdown. What do you think they bought when next in the market in 1946? That's right . . . another VU (much bigger than the first).

An automobile company installed its first VU Units (2) in 1947. Two more were ordered for another of its plants in 1948; then three more units for a third plant in 1949 and two more for still another plant in 1950.

A refinery ordered its first VU Unit in 1937. In 1941 another was installed and still another in 1950. For another of its plants two units were ordered in 1942 and a third in 1947.

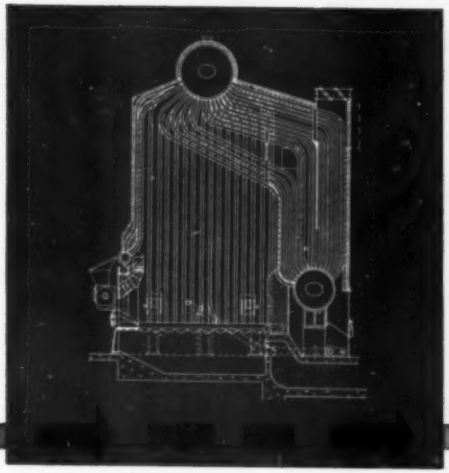
An electric utility company installed its first VU Unit in 1941. Two more units were ordered for another of its plants in 1947, a unit for a third plant in 1946 and still another for a fourth station in 1949.

* * *

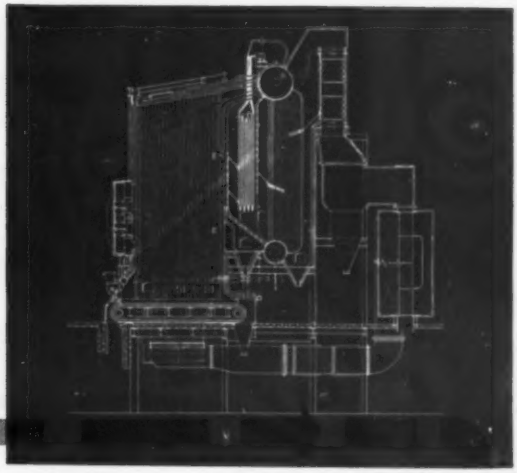
And so it goes — in all sections of the country — and abroad — industry after industry ordering and *reordering* VU Boilers. There must be a reason—and there is. The VU's advanced design, rugged construction and consistent reliability have become a service-proved answer to lower steam costs. You can choose VU with confidence based on the experience of companies in *your* industry, in *your* area. B-485

COMBUSTION ENGINEERING

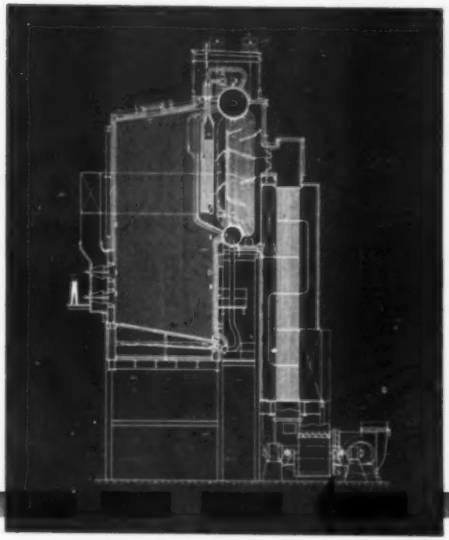
ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS



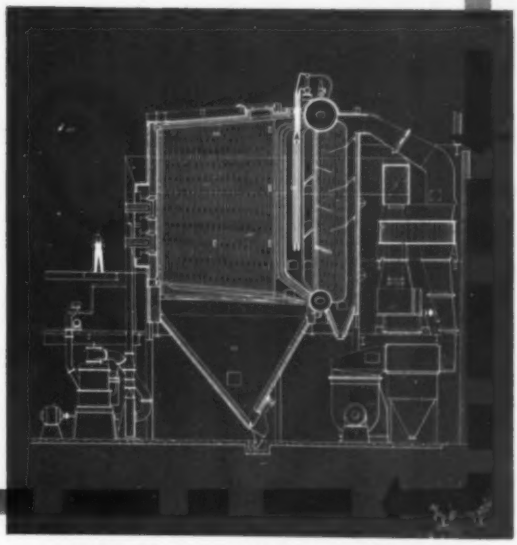
VU-10 Unit fired with C-E Spreader Stoker (dumping grate type). VU-10 Boilers range in capacity from 10,000 to 60,000 lb of steam per hr. May also be fired by underfeed or chain grate stokers, or by oil or gas.



VU-30 Unit fired with C-E Spreader Stoker (continuous discharge type); auxiliary gas and oil burners in upper front wall. Capacity of unit shown is 90,000 lb steam per hr; operating pressure—650 psi; steam temperature—825F.



VU-30 Unit fired with natural gas or oil. Design provides for future pulverized coal firing. Capacity of unit shown is 350,000 lb of steam per hr; operating press.—920 psi; steam temp.—905F.



VU-50 Unit fired with pulverized coal using C-E Raymond Bowl Mills. The capacity of unit shown is 150,000 lb of steam per hr; operating pressure—600 psi; steam temperature—700F.

— SUPERHEATER, INC.

200 MADISON AVENUE, NEW YORK 16, N. Y.

C-E

high efficiency
AEROTEC
DUST COLLECTORS
Partially erected collector showing inlet, outlet and dust discharge passages.
New Niagara-Mohawk Power Corporation Dunkirk Steam Station, equipped with Aerotec Dust Collectors.
assure your plant
the same protec-
tion given the new

NIAGARA MOHAWK POWER CORPORATION

Dunkirk Station . . . and a duplicate Albany Plant

At the new Dunkirk Steam Station of Niagara Mohawk Power Corporation, two reheat steam generators of 670,000 lb. per hour capacity are pulverized fuel-fired. Dust collection for this station is handled by Aerotec, Design 3 RAS Collectors, and a duplicate system is under construction for the new Albany Steam Plant . . . making a total of eleven Niagara Mohawk boilers to be equipped with Aerotec Dust Collectors.

The collectors for Dunkirk and Albany consist of 84 "Unit Building Block" elements completely assembled at the factory for easy erection in the field. The small diameter tubes, of permanent molded aluminum construction, have proved their extremely high collection efficiency and long life on hundreds of installations. Their light weight cuts steel requirements for supporting structure, and makes possible roof installations with a minimum of reinforcement. The light weight tubes also reduce erection costs.

Aerotec efficiencies meet or exceed the requirements of most dust ordinances today. Evenly spaced tube outlets provide excellent inlet flow conditions for an AEROTEC electrical secondary—should future ordinances require still higher efficiencies.

Write for the new Design 3 RAS Catalog No. 601.

Project and Sales Engineers

THE THERMIX CORPORATION

GREENWICH, CONNECTICUT

(*Offices in 28 Principal Cities*)

Canadian Affiliates: T. C. CHOWN, LTD.
1440 St. Catherine St., W., Montreal 25, Quebec • 50 Abell St., Toronto 3, Ontario

THE AEROTEC CORPORATION

GREENWICH, CONNECTICUT

Manufacturers of mechanical dust collectors, electrical precipitators, air cleaners, industrial integral dust collectors, gas-oil scrubbers and dust reclaiming equipment.

New equipment and developments

(Continued from page 16)

trols. Infinite speed range is provided by a simple, durable mechanism. The unit is mounted above the conveyer worm providing easy servicing and reducing the possibility of damage resulting from flooded pits and boiler rooms.

Additional information on new equipment and development items is available. Use card inserted between pages 132 & 133

18—AIR HAMMER OPERATES AT 120 PSI

The Pneumatic Tool Div. of Salsbury Corp., announce the availability of their Model G-200 air hammer, a light hand tool weighing just slightly over 2 lb, but so designed that it will perform medium-heavy duty work in general shop and maintenance

operation. Working at 120 psi this hammer strikes up to 6000 blows per min, with maximum force, or may be metered to any lower speed or striking power by means of a simple finger trigger action. An outstanding safety feature is the patented 3-point ballbearing chuck, which locks tools in working position and eliminates hazard of tool ejection. Driving piston constitutes the only moving part.

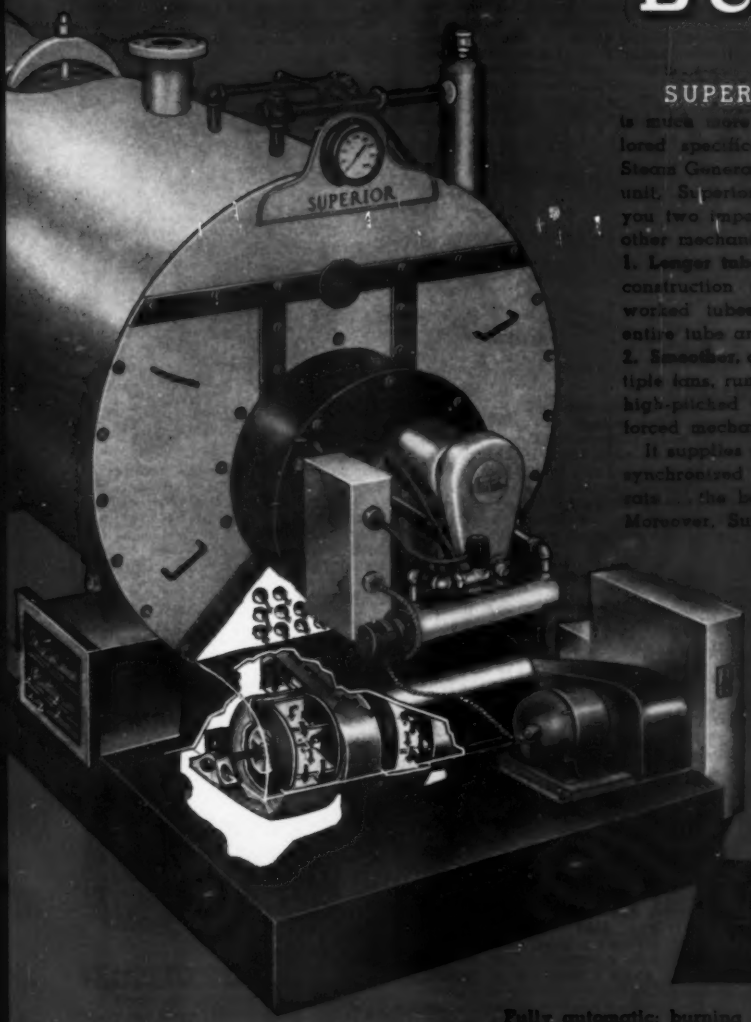
19—RELIEF VALVE ACCURATE AT 2 PSI

Andrews-Alderfer Processing Co., Inc. announced the availability of type A-120 relief valve that features positive, accurate control on 2 psi air pressure and large volume exhaust at 3 psi. Recommended for

applications in which accurate pressure control of air or gases is vital, the valve is only 1-1/8 in. high and 7-3/8 in. in over-all diameter. Working parts are mounted in a flexible rubber base and are fully protected by a steel cap and rubber shield. Components are fabricated from stainless steel and natural or solvent-resistant neoprene rubber

(Continued on page 22)

BETTER *because it's* BUILT-IN



SUPERIOR'S INDUCED DRAFT is much more than accessory equipment. Tailored specifically to its function in Superior Steam Generators, and built-in as an integrated unit, Superior's Induced Draft System offers you two important advantages not common to other mechanical-draft boilers.

1. Longer tube life . . . because full-width fan construction minimizes the danger of overworked tubes by its even draw across the entire tube area.

2. Smoother, quieter operation . . . because multiple fans, running at low speeds, eliminate the high-pitched whine commonly associated with forced mechanical draft.

It supplies air in precisely measured volume, synchronized with the oil flow at every firing rate . . . the basis of high operating efficiency. Moreover, Superior's Induced Draft eliminates the possibility of leaking combustion gases into the boiler room.

These, in themselves, are very substantial reasons for specifying Superior Steam Generators, but for the whole story, write for Catalog 112.

STEAM GENERATORS

Fully automatic; burning gas or oil, or both
80% thermal efficiency guaranteed.
18 sizes from 20 to 600 b.h.p. for pressures up to 250 p.s.i.

uperior ombustion ndustries, inc.

Factory: Emmaus, Pa.
Executive Offices: Times Tower, Times Square, New York 18, N. Y.

New equipment and developments

(Continued from page 20)

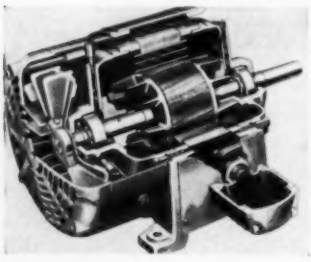
stocks. It can be attached to either flexible or rigid surfaces. Attachment to flexible surfaces is accomplished by cementing valve base to the unit it will control. For mechanical mounting, the valve is supplied with bolt holes in the base according to customers' specifications.

20—HUMIDITY INDICATOR EASILY READ

The Airguide direct-reading hygrometer, which is being used extensively by the U. S. Armed Services, is now available for general use. The manufacturers, Fee and Stemwedel, Inc., claim that this instrument provides the simplest means yet devised for keeping constant and accurate check on relative humidity. Easy to read as a clock and reasonable in price, this addition to the popular Airguide weather instrument line should win wide acceptance with many types of manufacturers, storage houses, testing laboratories, and other commercial concerns where the maintenance of constant humidity conditions is essential to operating efficiency and healthful and comfortable working conditions.

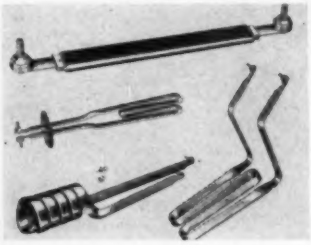
21—ENCLOSED MOTOR IS EXPLOSION PROOF

A ten-feature totally enclosed motor for explosion-proof requirements has been developed by U. S. Electrical Motors, Inc. Made in capacities from 3 to 75 hp, this motor, types SE and SES, carries the Underwriters' label in Class 1, Group D, for highly inflammable gases and volatile liquids, and in Class II, Groups F and G, for combustible dusts. Other types SD and SS, without label, for non-explosion-proof services are also available. Being completely sealed, this motor gives protection against external hazards and prevents intrusion of deleterious substances.



22—ELECTRIC IMMERSION HEATING ELEMENT

Syntron Co. announces the manufacture of a very flat, sheathed electric heating element, for industrial heating for immersion in liquids. It provides flat surfaces for contact heating and a thin section for convection and air flow. The device is readily bent and formed and is resistant to moisture and vibration. Flat surfaces, 5/32 in. thick, promote efficient radiation effects. They can



be supplied with self-regulating characteristics where wattage will vary inversely with heater temperature. Copper and steel are standard sheath materials although other alloys or plating and various coatings can be supplied. A variety of terminals are available or the heaters may be brazed or welded into various fittings or provided with holddown straps or brackets.

Additional information on new equipment and development items is available. Use card inserted between pages 132 & 133

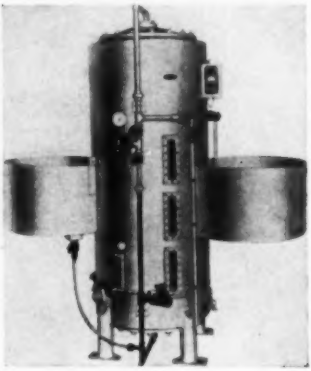
23—NON-SLIP FLOOR PREVENTS ACCIDENTS

Fera-Mat, a non-slip long-life floor covering designed to prevent serious slipping accidents has been introduced by American Abrasive Metals Co. This product provides a non-slip walking surface composed of durable mineral granules, which are resin-bonded to a heavy duty weatherproof cloth backing. Available in cleats measuring 6 x 24 in. or in rolls measuring 6 in. wide by 96 ft long. Rolls come only in black, but cleats are made in black, red and green. Supplied with a protective liner on the underside, which is peeled off at the time of installation, the new non-slip floor covering has a pressure sensitive adhesive, which makes it adhere firmly to any clean, dry and smooth surface.

For industrial applications, the new non-slip product helps to eliminate costly "lost-time" accidents. Being non-rigid, the floor covering permits reasonably heavy loads to pass over it without damage. Increased traction cuts down lost motion and fatigue and increases worker's productivity. Maintenance is simple since dirt can be brushed out. Recommended for steps, ramps, platforms, factory floors, walkways, catwalks, washrooms, cafeterias, docks, warehouses, running boards, storerooms, step-ladders, entrances, decks, passageways, exits, production lines, slippery surfaces, aisles, storage tanks, fire escapes, flat steel plates and corridors.

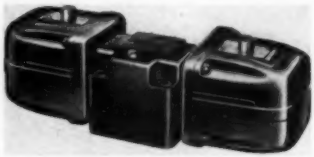
24—DEMINERALIZER PURIFIES WATER

The Penfield Mfg. Co. has announced the availability of a Mono-Bed demineralizing unit operating on an effective deionizing technique. Cation and exceptionally strong base anion exchangers are intimately mixed in a single unit tank, thus providing in one container the equivalent of a large number of multiple bed systems. Raw water passes through this column only once. These units are suitable for a large number of industrial operations, wherever completely mineral-free water is required. Models are available ranging from a few gph to 5000 gph and up.



25—HYDRAULIC VALVE ENDS SPOOL-STICKING

To overcome the problem of spool-sticking common to four-way solenoid valves in high pressure hydraulic circuits used for long cycling operations, Denison Engineering Co. has developed a pilot operated valve that utilizes system pressure to move the spool. Solenoids are used only to operate small internal pilot valves. Spool action is said to be smooth, quick and positive under all operative conditions to 5000 psi, the valve being designed so that the spool always moves at the same rate of speed regardless of operating pressures.



Available in ¾ and 1-½ in. sizes, in both single- and double-solenoid types, with provision for either external or internal pilot connections. Eight types of spools provide for eight different porting combinations,

(Continued on page 136)

EVERYTHING FOR PIPING

in 30 principal cities*

*with Grinnell jobbers in practically every city

30 GRINNELL WAREHOUSES AND SALES OFFICES

provide the products, facilities and experience "whenever piping is involved"

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pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco humidification and cooling systems

LOW PRESSURE?

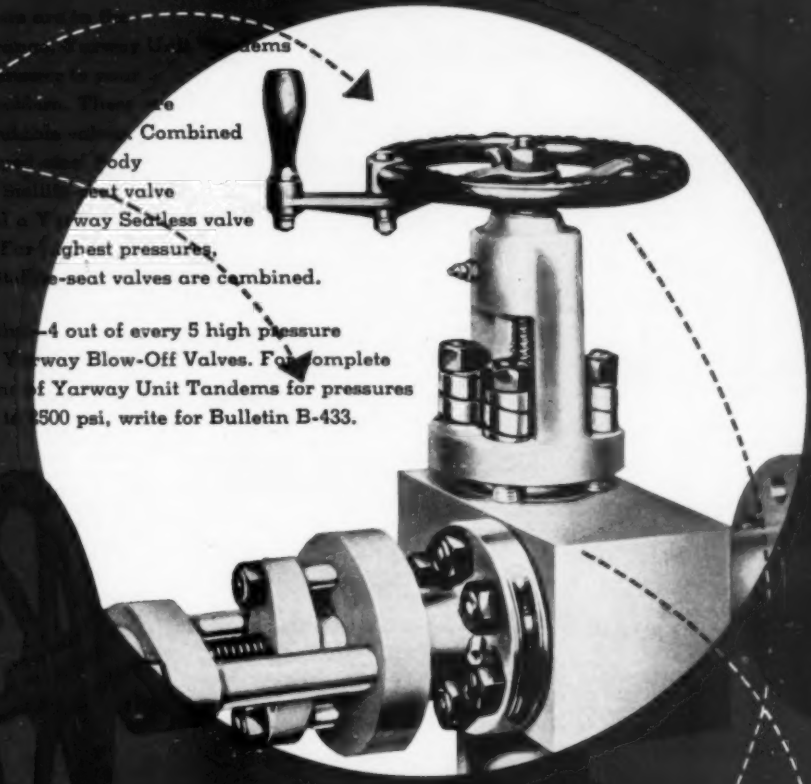
Thousands of low pressure boiler plants rely on Yarway Seatless Blow-Off Valves to keep blow-down lines tight. Famous balanced sliding plunger design eliminates a common source of blow-off valve leakage. There is no seat to score, wear, clog and leak.

Yarway Seatless Blow-Off Valves are furnished in tandem, as shown, or singly—angle or straightway.

For complete specifications of Yarway Blow-Off Valves for pressures to 400 psi, write for Bulletin [illegible].

STU

HIGH PRESSURE



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YARWAY

BLOW-OFF VALVES

BLOW-DOWN TROUBLES—KEEP BOILERS ON THE ... 60

New bulletins and catalogs

You'll want to check these new bulletins and catalogs carefully as they have been screened by our editors to make sure they contain new information of value to you.

See Reader Service Card Page 132

BOILERS, AUXILIARIES, ACCESSORIES

200—Packaged Steam Generators. Engineers concerned with providing heat, power or hot water may find it helpful to study the installation, operating and other advantages offered by "steam in a package". Bulletin 1D51-115, 12 pages, presents facts on self-contained steam generator of three pass, forced down draft, horizontal fire tube design. Operating features are pictured and described, and information on sizes and fuels is given. Photos illustrate case histories showing actual dollar savings. Specifications and ratings table included. York-Shipley, Inc.

201 — De-Scalers. Electronolytic descalers for all type of high and low pressure steam boilers are described in 4-page bulletin. Explains advantages and shows how to install the units. Tables give information on life expectancy of the units along with data on number of de-scalers required for specific horse power ratings. Butler Engineering Co.

202—Silica Cement. Descriptive information on silica cement for use in laying silica refractories is contained in 4-page bulletin. Includes photographs showing results of comparison tests. Among properties illustrated are comparative effects of heat treatment; refractories, trowelling and settling. Harbison-Walker Refractories Co.

203—Finishing-Insulating Cement. Illustrated folder describes finishing cement that insulates. Shows economical advantages and gives characteristics of the material. Includes thermal conductivity chart. Baldwin-Hill Co.

204—Refractories. Technical information of a basic nature on line of refractory products is given in 20-page booklet 5120. Supplemented with charts, tables and illustrations that make it valuable aid in selecting proper refractory. Refractories Div., The Carborundum Co.

205 — Industrial Insulation. Cements, flats, fills, pipe coverings, protective coatings and anti-condensation compounds are covered in 22-page bulletin A91. Characteristics of each type along with application data are given. Contains seven pages of engineering data including charts on recommended thickness, heat losses, and formulas for calculating heat savings along with many reference tables. The Eagle-Picher Co.

206—Fuel Oil Additive. Concentrated chemical liquid added to fuel oil in tank is described in 4-page folder. Said to remove soot and carbon scale and aid in keeping burner nozzle and oil system clean. Tells advantages and gives directions on the use of the product. Lubaid Co.

207—Forced Draft Fans. Bulletin 300, 8 pages, describes design features of forced draft fans. Illustrates various types of fan-wheels, designed with backward curved blades. Various types of housing are also shown. Prat-Daniel Corp.

PRIME MOVERS: DIESELS, TURBINES, COMPRESSORS

208—Diesel Engines. Comprehensive bulletin illustrates and describes type FV diesel engines. Gives complete engineering data, specifications and power ratings. Lists such applications as locomotive service, draglines and electric power generation. Available in 6, 8, 12 and 16 cylinder types. The Cooper-Bessemer Corp.

209—Asbestos & Fibre Sheet Packings. 8-page bulletin features complete line of asbestos and fibre sheet packings. Gives complete description and illustrations of each type packing, together with full service recommendations, standard sheet sizes, and weights and thicknesses in which each type sheet is available. Raybestos-Manhattan, Inc., Packing Div.

210—Diesel Oil Additive. Folder tells what this solvent is and what it does to aid in efficient engine performance. Includes directions and proportions for applying. Lubaid Co.

211—Turbine Oil Maintenance. Bulletin 832P, 12 pages, describes and illustrates dry-type oil maintenance methods for turbine bearings. Importance of continuous oil maintenance, and factors which cause turbine oil deterioration are fully explained by charts, diagrams and phantom views. Various types of turbine oil maintenance systems are shown with their capacities and dimensions. Also covers system for maintaining insulating oil dielectric in transformers, circuit breakers and switches. Bowser, Inc.

HEAT EXCHANGERS

212—Heat Exchangers. Equipment for distribution and utilization of steam, gas and liquid is briefly described in illustrated folder 349. Refers to specific bulletin for more detailed information. Eight types of expansion joints, four heat exchangers and several types of meters and strainers are shown. Also pictures and describes various accessories for pipe lines. American District Steam Co.

WATER AND LIQUID TREATMENT

213—Ion Exchange Material. Strongly basic anion exchanger is presented in 16-page bulletin 57. Includes complete data on physical characteristics, exchange capacity and regeneration technique. Tables and graphs along with discussions explain performance under various operating conditions. National Aluminate Corp.

214—Ion Exchange Material. Styrene type cation exchanger is covered in 28-page bulletin 58. Contains complete discussion, supplemented with tables and graphs. Physical characteristics, exchange capacity and regeneration technique given. National Aluminate Corp.

215—Ion Exchange Material. Bulletin 59, 6-pages, gives complete information on synthetic gel type zeolite for cation exchange. Technical discussion along with tables and graphs show performance. Characteristics, capacity and regeneration technique are explained National Aluminate Corp.

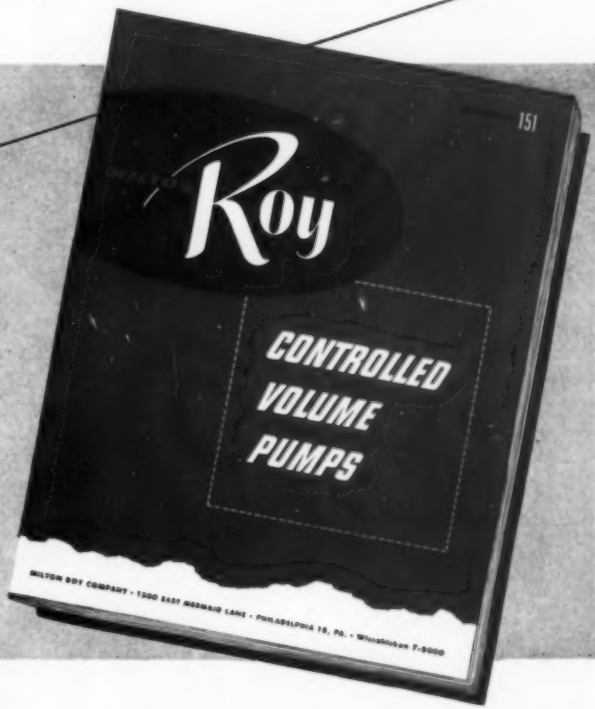
216—Return Line Corrosion Control. Bulletin 5013, 4 pages, covers causes of return line corrosion and recommends and explains corrective treatments. Includes information on clear amine type liquid which dissolves in the condensate, and reacts with carbon dioxide preventing carbonic acid, and filming-type amine which forms continuous film in return lines, coating them against both oxygen and carbon dioxide corrosion. Also contains test procedures for both treatments. Dearborn Chemical Co.

217—Zeolite Softeners. Thorough explanation of the sodium zeolite softening process is contained in 32-page bulletin 4520. Tables and discussions on rating and zeolite selection make it easy to choose correct size and material for specific conditions. Describes hydromatic single control valve and its advantages along with other features. Cutaways, exploded photos and diagrams illustrate some arrangements possible with the units and accessories. Installation photographs included along with brief descriptions of other water conditioning products. Cochrane Corp.

(Continued on page 30)

CONTROLLED VOLUME PUMPING

This Milton Roy Bulletin No. 151 Gives You COMPLETE DETAILS



Bulletin No. 151 is filled with information on controlled volume pumping. Here are a few of the many important details you'll find in the book:

- an explanation of controlled volume pumping.
- a description of what controlled volume pumping can do for you—what it does for others in the chemical, textile, petroleum, pulp and paper, paint, food and beverage, water treatment, pharmaceutical, and brewing industries and in instrumentation, pilot plants and laboratories.
- a description of how Milton Roy Controlled Volume Pumps give users maximum benefits; how any desired rate of delivery, from zero to full capacity, can be maintained with accuracy; how deliveries as low as 3 milliliters per hour can be held with precision; how difficult-to-pump materials, such as slurries, viscous liquids, solids in suspension, etc., are readily handled.
- 4 pages of color charts which show in dramatic "traffic-light" style the relative corrosion resistance of materials of construction to over 170 chemicals. These valuable reference charts summarize industry-wide data.
- a description of the features that make Milton Roy Controlled Volume Pumps perform flawlessly on services where no other pump has filled the need.

If your operations call for pumping a controlled volume of liquid in amounts as much as 50 gallons per *minute* or as little as 3 milliliters per *hour*, you'll find this book extremely valuable.

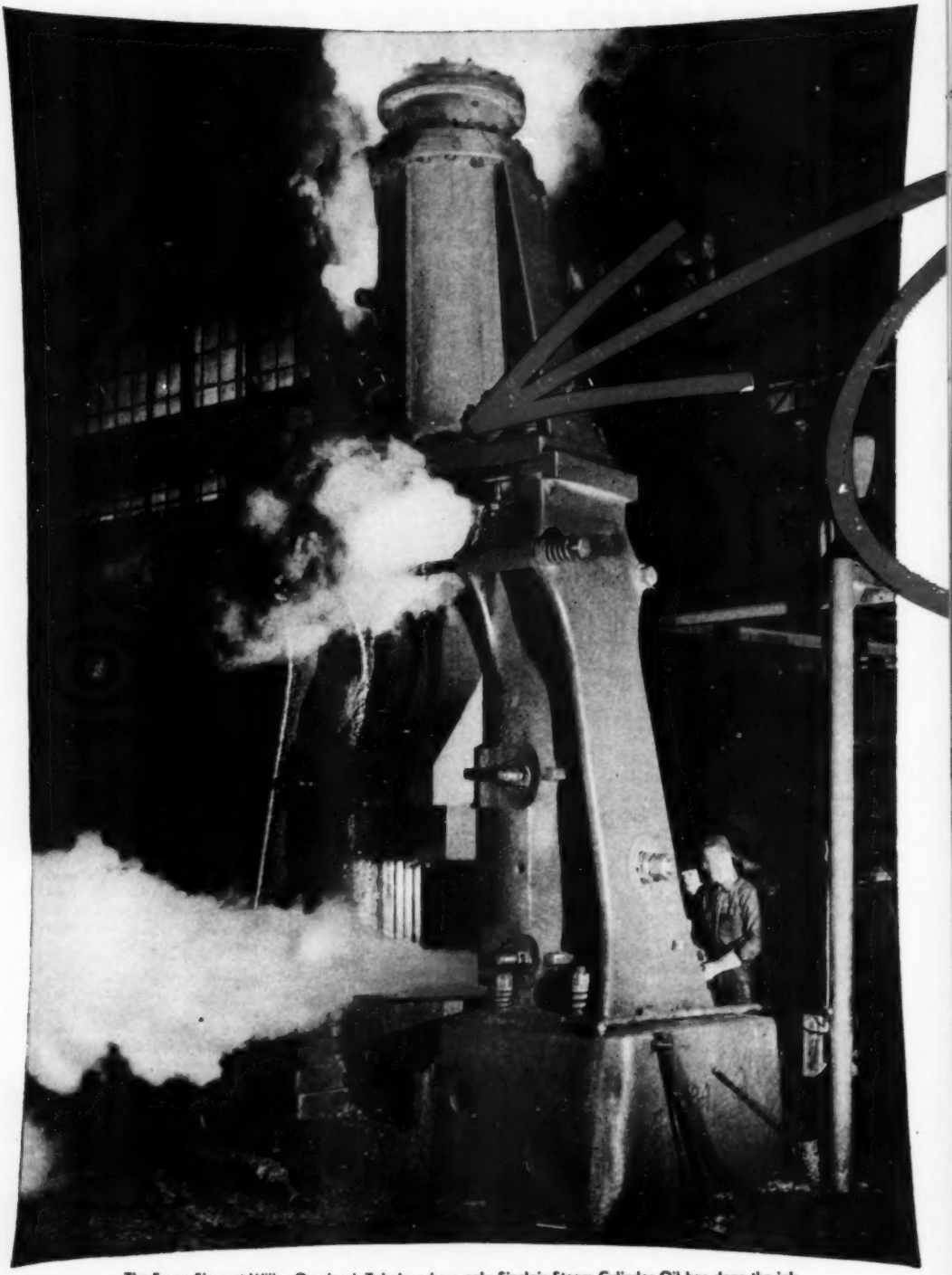
For your free copy of the 24-page, 2-color Milton Roy Bulletin No. 151, write or call the Milton Roy representative listed in your telephone directory. Or, if you prefer, write direct to us.

WITH THE EXCLUSIVE STEP-VALVE DESIGN

MILTON Roy COMPANY

1319 EAST MERMAID LANE, PHILADELPHIA 18, PA.

MANUFACTURERS OF CONTROLLED VOLUME PUMPS AND AUTOMATIC CHEMICAL FEED SYSTEMS



The Forge Shop at Willys-Overland, Toledo, where only Sinclair Steam Cylinder Oil has done the job.

"NO OTHER OIL has done this Job!"

reports Willys-Overland Forge

Mr. Wm. Paris, Vice President in Charge of Manufacturing at Willys-Overland Motors, Inc. says, "We have saved plenty of cylinders, packing, and down-time since shifting to Sinclair lubrication."

Rising production forced the mammoth Forge Shop at Willys-Overland to step up ram speed 30%. As the power was insufficient, the steam had to be raised to 400°F. by superheating. Then the lubrication problem started!

The hotter steam and faster ram speed quickly burned up packings, and cylinders became scored. Many lubricants were tried. All failed to halt the destruction... until the Forge tried Sinclair Valve Oil Light. Now it reports it hardly ever has a scored cylinder and no more lubrication headaches. The Forge does not believe it possible to get finer steam cylinder lubrication and emphatically concludes that, "No other oil has done this job!"

If you have a steam cylinder lubrication problem it can pay you to consult with Sinclair, for Sinclair makes a wide variety of Steam Cylinder Oils to handle every possible need. Get in touch with your nearest Sinclair Representative or write Sinclair Refining Company, 600 Fifth Ave., New York 20, N. Y.

SINCLAIR STEAM CYLINDER OILS

for every steam cylinder installation

The Ideal Packing for Centrifugal Pumps
"JOHN CRANE"
SUPER-SEAL®
over fifteen years of outstanding service records
...Now with "tape-back" reinforcement
★ SIMPLIFIED RING CUTTING—Easily pulled down to any shaft or stem size.
★ POSITIVE PACKING IDENTIFICATION—Each style marked in a different color.
Super Seal is an extremely resilient, graphite impregnated, homogeneous plastic packing composed of asbestos, metallic particles and special binders.
This packing is ideal for centrifugal pumps in a wide variety of power plant services. It doesn't give up its lubrication, it stays resilient and it won't score shafts. You'll find it will outlast any packing you've tried. There are no continual adjustment problems with Super Seal, because it stays put!
"Tape-back" construction meets your need for flexibility without breakage—for ring cutting without waste. Here, for the first time, is a plastic packing which can be handled as easily as braided fabric styles.
It's hard to believe the resilience of "tape-back" SUPER SEAL until you twist it down yourself. Send for a sample and try it.
JOHN CRANE
CRANE PACKING COMPANY
1831 CUYLER AVENUE • CHICAGO 13 ILLINOIS
Offices in All Principal Cities in United States and Canada

New bulletins and catalogs

(*Continued from page 26*)

218—Deionizer. Bulletin 512, 6 pages, describes single tank deionizers of mixed-bed, monoflo design. Lists features and explains economical benefits as compared to other methods of purifying water. Said to produce water free from all ionizable impurities including carbon dioxide and silica. Engineering and technical data covering sizes included. Elgin Softener Corp.

FILTERS, STRAINERS, CLARIFIERS, DEHYDRATORS

219—Purifier. Condensed bulletin 100 fully describes the operation, specifications, dimensions and features of internal type purifier said to remove virtually 100% entrainment from vapor. The 4-page folder contains dimensional drawings illustrating the use of purifiers inside two typical installations, steam drums and bubble-cap towers, as well as cutaway drawing showing vapor flow through the unit. Recommended applications are listed. Steam Specialty Div., V. D. Anderson Co.

Bulletins and catalogs reviewed here are yours for the asking. Use card inserted between pages 132 & 133

220—Aftercoolers & Separators. Cool, clean, dry air means high efficiency and economy in the use of compressed air. See how it's accomplished in 8-page bulletin 176. Includes full discussion along with illustrations on equipment required to do the job. Specifications and dimensions included. R. P. Adams Co., Inc.

221—Industrial Dust Control. General information on the subject of industrial dust control is contained in 24-page bulletin 98. Explains basic principles applied to solution of dust problems. Diagrams show just how filters work and tables give capacities and dimensions of the units. Illustrates and discusses equipment and accessories. Contains much helpful data for those concerned with dust control. The W. W. Sly Mfg. Co.

222—Porous Media. Knowledge of porous media should prove helpful in solving many filtration and air diffusion problems particularly in the water and sewage treatment fields. Booklet 5118, 56 pages, provides a great deal of information and data on aluminum oxide porous media. Contains discussions, drawings, diagrams, photographs, charts and tables to assist in the specification of porous material that will accomplish desired results. Refractories Div., The Carborundum Co.

(*Continued on page 33*)

HERE'S HELP, MR. BOILER OPERATOR . . . .

R&I Refractories and Insulations

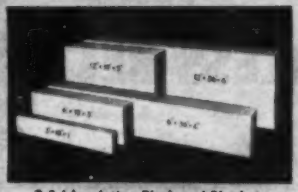
Can Help Speed Installation of New or Repair Old Equipment and Cut Time-Labor and Material Costs

R & I Super #3000 Bonding Cement

The strongest ready mixed mortar for laying brick and for repairs. Sticks tighter, sets harder, lasts longer.

R & I Moldit Castable Cements

Make poured refractory shapes of any size—ready in hours instead of days. Available for all temperatures and erosion conditions.



R & I Insulating Block and Blankets

Efficient, easy to install, strong. Standard and special sizes, thicknesses and shapes.

1 Cut Time and Cost of Delivery

Deliveries of refractory brick and tile now run from 6 to 12 months. Certain insulating materials are also in short supply. Can you afford these long delays? R & I Refractory Cements and Insulations are available on short notice, assembled in the desired quantities of various products and shipped promptly from our single large plant. This saves time, freight rates and shipping costs.

2 Cut Time and Cost of Installation

R & I Moldit Castable Refractory Cements—a type for your every need—make it easy to pour monolithic refractory walls, arches, floors, linings and special shapes. They're ready for service in 24 hours. Installation is faster, easier, more economical than with other types of refractory construction. R & I Insulating Block and Blankets likewise expedite installation of new equipment.

3 Reduce Outage Time for Repairs

With R & I Moldit Castables and Bonding Cements, repairs and maintenance can be made quickly, with minimum outage. And, most important, R & I jobs last longer even under extreme conditions of mechanical and thermal shock.

Learn about R&I Quality Products for Furnace and Boiler Construction and Repairs. Send this coupon.

REFRACTORY & INSULATION CORP., 118 Wall St., New York 5, N. Y.

Send me ..... *Copies of the New R&I Catalog.*

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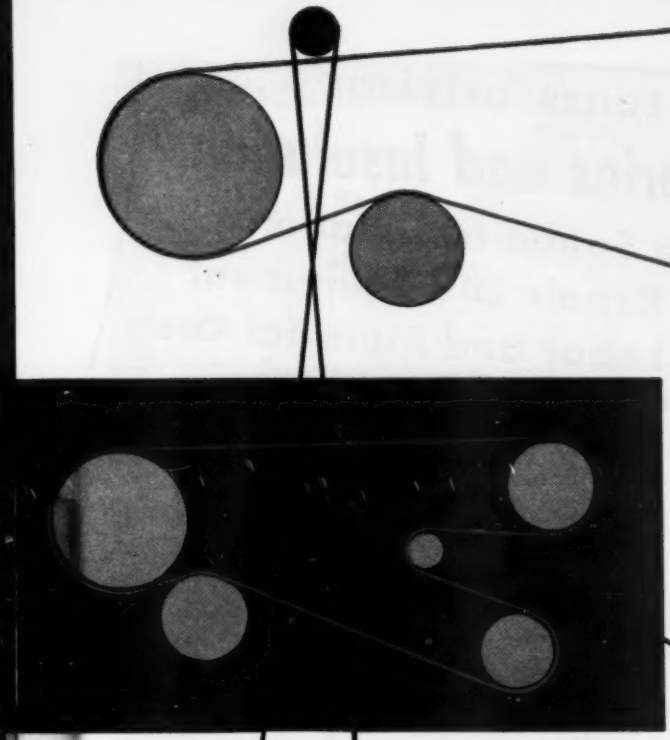


short turns at high speeds

Condor WHIPCORD ENDLESS BELTS

"I was beginning to think no flat belt could stand up on that drive . . . but now I've found a belt I don't believe any drive can kill!"

Statements like this are typical from users of Condor Whipcord Endless Belts on troublesome drives . . . short centers . . . small pulleys . . . reverse bends . . . high speeds . . .

The endless-wound cord is destretched in manufacture to remove inelastic stretch. Cover-end is made inseparable with the Extensible-Tip. These and other advantages are described in Bulletin 6869 D, mailed on request.

This same rugged service is built into R/M hose, V-belts and conveyor belts. Just phone your R/M Distributor.

MANHATTAN RUBBER DIVISION—PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.

Manufacturers of Mechanical Rubber Products • Rubber Covered Equipment • Radiator Hose • Fan Belts • Brake Linings • Brake Blocks • Clutch Facings • Packings • Asbestos Textiles • Powdered Metal Products • Abrasive and Diamond Wheels • Bowling Balls

New bulletins and catalogs

(Continued from page 30)

ELECTRICAL EQUIPMENT

223—Battery Chargers. Four-circuit, motor generator battery charger is covered in 4-page bulletin 11-220. Features and advantages of the fully automatic, self contained unit are illustrated and discussed. Simple operating instructions are contained as are selection table and dimensions. The Electric Products Co.

224—Distribution Transformer. Wound type core combined with new insulation applications said to provide smaller unit with greater thermal capacity and better voltage regulation is described in 4-page bulletin 61B7641. Lists construction features and includes dimensions for conventional and self-protected types of oil-immersed, self-cooled, single-phase transformers built in accordance with EEI-NEMA standards in ratings to 25 kva. Allis-Chalmers Mfg. Co.

225—Mica Capacitors. Industrial and other type mica capacitors are thoroughly covered in 60-page catalog 420-421. Contains a wealth of electrical, physical and application data in detailed and convenient manner. Five pages of informative technical data on selection, use and method of specifying are included. Detailed dimensional drawings are given. Cornell-Dubilier Electric Corp.

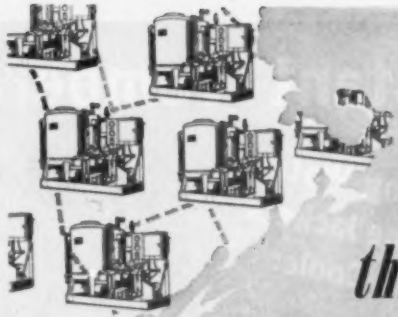
Bulletins and catalogs reviewed here are yours for the asking. Use card inserted between pages 132 & 133

226—Induction Motors. Large, end-shield bearing, squirrel-cage, induction motors are described in 6-page bulletin 05B7542A. Applications range from central station auxiliary to general industrial drives and are available in ratings and speeds up to 1750 hp at 1800 rpm, according to the booklet. Although construction features are listed, the bulletin points out that numerous mechanical and electrical modifications are available. Allis-Chalmers Mfg. Co.

227—Single-phase Inductrols. Bulletin GEC795, 18 pages, describes features of redesigned inductrol equipment; its application and operation. Also contains sketches, line drawings, and charts showing operating connections. Price and purchasing data on the equipment, rated 0.3 to 24 kva, for use in circuits rated 3 to 240 kva, is included. General Electric Co.

228—Packaged Power. Bulletin GEA 5600 outlines methods of obtaining elec-

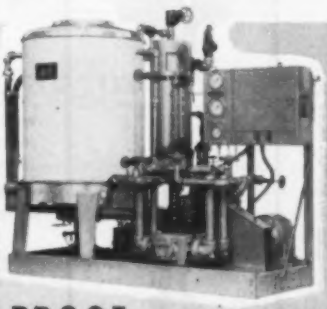
(Continued on page 146)



In *thrifty* NEW ENGLAND...

THERE ARE MORE *Clayton* FORCED RECIRCULATION STEAM GENERATORS IN USE THAN *ALL OTHER PACKAGE TYPE BOILERS COMBINED

*Self contained steam generators of from 15 to 100 horsepower



for the reason and proof of this statement mail the coupon

THIS COUPON BRINGS PROOF TO YOUR DESK

An animated, colored flow chart shows you how and why the Clayton Forced Recirculation principle can cut your steam costs.

19-10

CLAYTON MANUFACTURING COMPANY
Box 550, EL MONTE, CALIFORNIA

Send name of nearest distributor and arrange desk demonstration of Clayton Forced Recirculation principle. Send catalog.

NAME_____

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CITY_____

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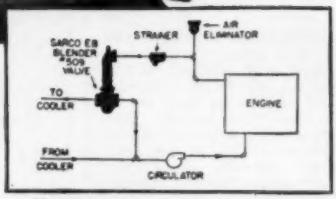
Box 550, EL MONTE, CALIFORNIA

Constant Temperature...

of Cooling Water for Engine Jackets and Oil Coolers

Atlas Imperial Diesel Engine, equipped with Sarco type EB blender to maintain constant jacket water temperature by re-circulating a varying portion of the cooling water.



Note the compact installation and simple piping. Also shown are the Sarco air vents and strainers which are necessary for efficient operation of the cooling system.

Sarco type EB Self-contained Water Blender, with built-in liquid-expansion thermostat for re-circulating control.

Sarco Blenders, by maintaining constant cooling water flow with controlled outlet temperature, insure rapid warm up, correct running temperatures and minimum temperature rise.

Simple, dependable Sarco controls prevent over-cooling or under-cooling, thus reducing wear on liners and rings, caused by cylinder condensation.

Smaller temperature fluctuations reduce stress and result in longer operating life and less maintenance.

Controlled Lube Oil temperature assures efficient lubrication.

Full information in Bulletin 702, sent free on request.

347

SARCO COMPANY, INC.

EMPIRE STATE BUILDING, NEW YORK 1, N. Y.

SARCO CANADA LTD., TORONTO 5, ONTARIO

REPRESENTED IN PRINCIPAL CITIES

This supply line is geared for your stepped-up production

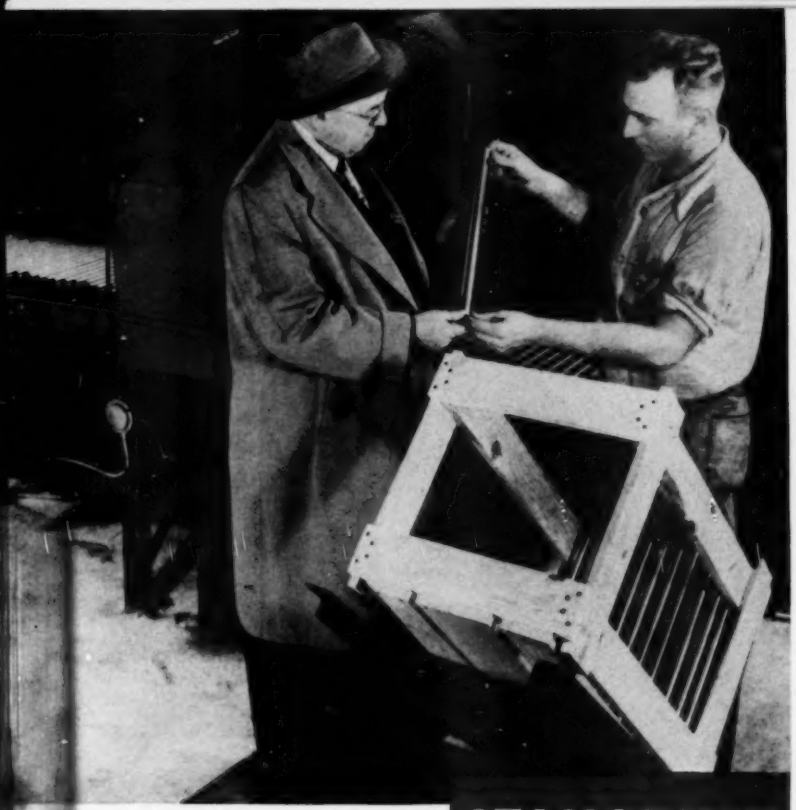
AMERICA REARMS. This rearmament program undoubtedly means that your plant has, or will have, a greatly stepped-up production schedule. And with new machines and new operations, new lubrication problems are created.

That's where we come in. A Standard service-supply center is near your plant. Any petroleum product you need can be delivered to your door within a few short hours. You need never worry about production delays, and you can avoid the expense of stocking large supplies of lubricants and fuels within your plant.

Your nearby Standard service-supply center is your always-dependable Supply Line. It is also headquarters for a Standard lubrication specialist, a man specially trained to give you expert and thorough advice on any lubricating problem, is also available through this service-supply center. His services, along with Standard Oil's efficient supply service, can help your important production go like clockwork.

To arrange for a visit from your nearest lubrication specialist, phone your nearby Standard Oil service-supply center or write to: Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD OIL COMPANY (INDIANA) STANDARD



STANORUST

REG. U. S. PAT. OFF.

Rust Preventives

A clear case of rust prevention

● Without a protective coating, these ground finish steel tubes showed rust marks even before the customer could assemble them. A heavy black oil type coating proved difficult and messy to apply, resulted in an unattractive product, and called for a cleaning operation on the part of the customer.

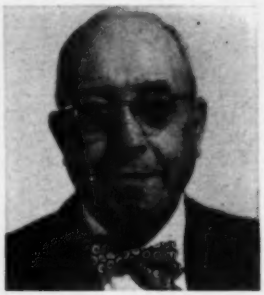
That was the situation at Central Steel Tube Co., Clinton, Iowa, when a Standard Oil lubrication specialist recommended STANORUST Rust Preventive No. 4-V. Tested and approved, STANORUST was put to work.

Now, these same parts are easily and automatically sprayed after grinding. STANORUST No. 4-V leaves a slightly oily, transparent coating that shows the ground finish to advantage, yet allows handling of the parts without fear of fingerprint corrosion. Shipped to the customer, they arrive bright and rust-free, ready for assembly without removal of the protective coating.

STANORUST No. 4-V provides exactly the degree of protection required in this case. It is one of eight grades in the STANORUST line . . . one of which is the answer to your own rust prevention problem. For details, call on your Standard lubrication specialist. Contact the Standard Oil Company office in your area, or write:

Standard Oil Company, 910 S. Michigan Ave., Chicago 80, Ill.

What's your problem?



E. J. Newel, who makes his headquarters at Standard's Des Moines office, is the lubrication specialist who helped Central Steel Tube Co. put an end to rust prevention problems through the use of STANORUST No. 4-V.

Throughout the Midwest there is a corps of such specially trained, experienced lubrication specialists ready to give you prompt, on-the-spot help with any lubrication problem. Each of these men has been carefully trained in a Standard Oil Lubrication Engineering School to supplement his own background of practical experience. It's easy to get the services of a lubrication specialist—just phone or write to your local Standard Oil Company office. When he stops by to see you, ask him about the following quality Standard products.

STANOIL Industrial Oils—This multi-purpose line of oils provides cleaner operation of hydraulic units, supplies effective lubrication in compressors, gear cases, and circulating systems. One or two grades can replace a wide variety of special oils and lubricants.

SUPERLA Greases—Available in lime soap and soda soap types, SUPERLA Greases cover a wide range of applications. These products are comparable in quality to the highest type of special greases but are as readily available and economical as ordinary cup greases.

STANDARD OIL COMPANY STANDARD *(Indiana)*

WHEN INSTALLING THE MODERN

SCHRAMM AIR COMPRESSORS

Complete assembled SCHRAMM units are furnished with compressor and motor mounted on a substantial steel base, which can serve as a foundation. No deep pit foundation or time and expense consuming "built-up" concrete foundation is necessary.

En-Bloc construction is one of the many contributing factors to this feature in the SCHRAMM Modern Stationary Compressor. The single block casting contains all of the cylinders, the main crank shaft bearing supports, camshaft bearing supports and the complete lubricating system.

SCHRAMM Compressors are built for 24-hour continuous service, in sizes ranging from ½ to 100 horsepower.

Write for booklet C-50B for further information.

SCHRAMM INC.

The Compressor People

WEST CHESTER • PENNSYLVANIA

SCHRAMM, INC. • WEST CHESTER, PA.

Please send Free Booklet C-50 B on installing Stationary Air Compressors.

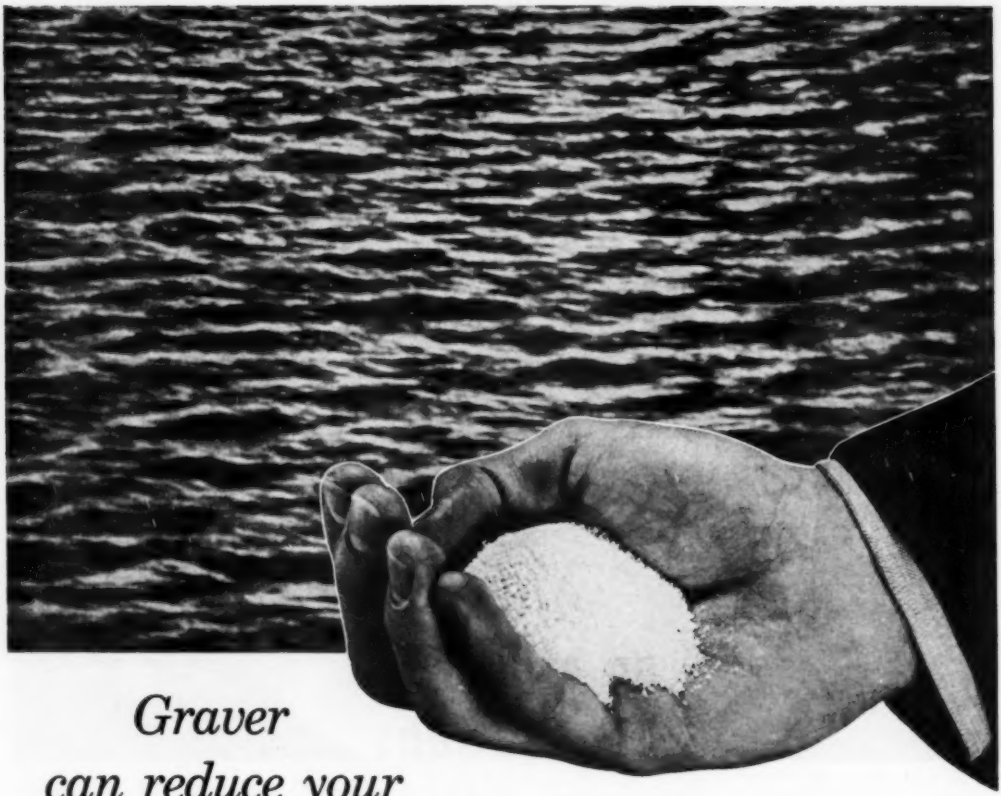
*Name*_____

*Title*_____

*Company*_____

*Street*_____

*City*_____ *Zone*_____ *State*_____



Graver can reduce your water solids to

LESS THAN a handful in a million gallons

That's equivalent to water with a purity of 0.1 ppm or 0.8 lb per million gallons . . . practically distilled water.

How does Graver do it? . . . with a MIXED-BED single tank demineralizing unit. Simple in operation, it can even be automatically controlled. Graver cation and anion exchange resins are mixed intimately, and simultaneously remove both cations and anions from the water being treated in this single unit. By combining certain Graver resins the silica in the water can also be reduced to 0.02 ppm and the carbon dioxide content can be reduced to zero.

Graver Demineralizers can accomplish these results in installations ranging in size from small laboratory units to huge plants in central power generating stations. The performance of each Graver installation is *guaranteed* . . . and this guarantee is based on Graver's 40 years of experience in designing successful water treating equipment of every type. Write for complete information.

GRAVER

GRAVER WATER CONDITIONING CO.

Division of Graver Tank & Mfg. Co., Inc.

216 WEST 14th ST., NEW YORK 11, N. Y. • CHICAGO • PHILADELPHIA • CLEVELAND

GW 440

STOP RUST WITH RUST-OLEUM

Why let rust—the most destructive enemy of American [illegible] —rob you of [illegible] to-repl[illegible] stack[illegible] fire escapes and other valuable equipment.

Use RUST-OLEUM in your plant to protect [illegible]. For 25 years RUST-OLEUM has proved its [illegible]city to stop rust for many nationally known manufacturers. Its tough, pliable, rust-resisting film gives excellent protection that prevents rust losses under many difficult rust-producing conditions—salt air, dampness, industrial fumes, and general weathering.

RUST-OLEUM can be applied even over rusted surfaces. It is not necessary to remove all the rust. Just remove scale and loose rust by [illegible] and wire [illegible] [illegible] maintenance procedure [illegible] chemical preliminary or sand blasting is usually required.

A qualified RUST-OLEUM [illegible] rust problems and help you develop a program of plant-wide rust control to defer many costly replacements — to conserve the available supply of new metal for national defense.

Industrial Distributors in principal cities of the United States and Canada carry complete stocks for immediate delivery. Plan your needs—order *now!* See our complete catalog in *Sweet's* which also tells the nearest source of supply. Or, write on your company letterhead for full information.

"RIGID ECONOMY, MON!"

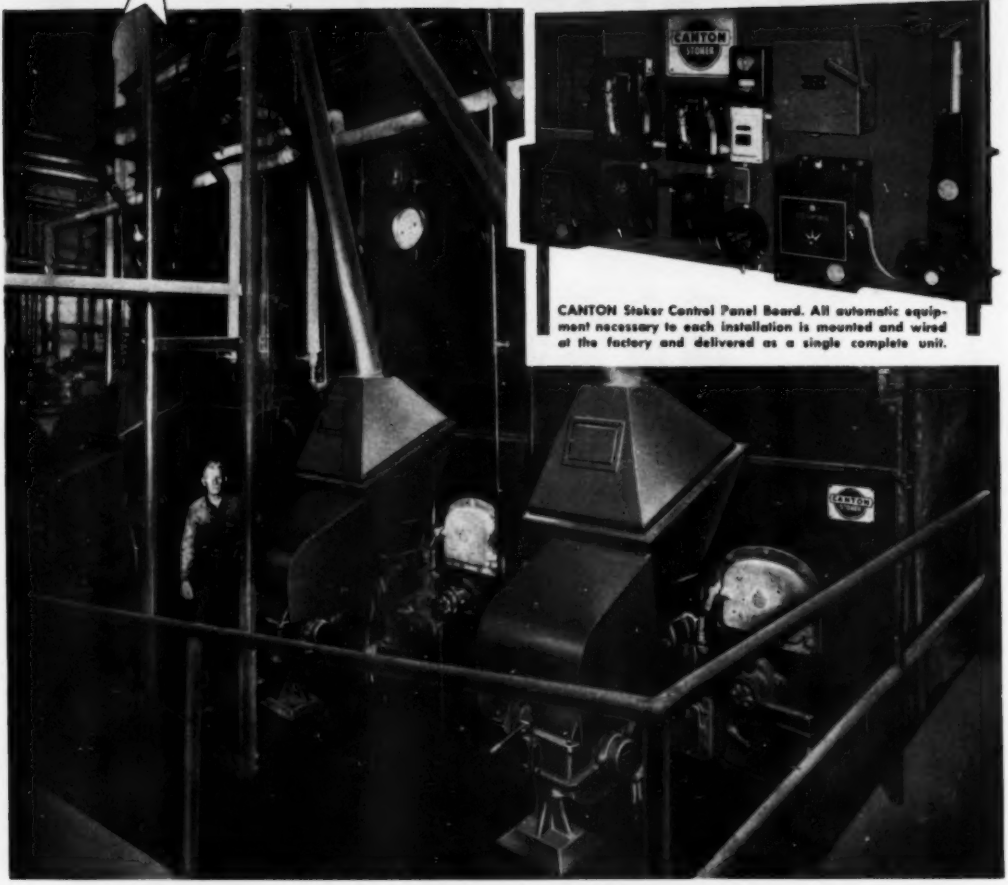
Available in many COLORS aluminum and white

Beautifies as it Protects

RUST-OLEUM CORPORATION
2473 Oakton Street, Evanston, Illinois

It's No Trick to Save Money

CANTON Stoker Control Panel Board. All automatic equipment necessary to each installation is mounted and wired at the factory and delivered as a single complete unit.



Multiple installation of CANTON Vulcan Ramfeed Stokers under 300 HP Water Tube Boilers at Utah State Capitol Bldg., Salt Lake City, Utah.

CANTON

SINCE 1910

...with a GOOD STOKER!

CANTON STOKERS

During the past forty years, thousands of users have learned that the superior construction and operating features of Canton Stokers provide worthwhile savings. Their dependable and efficient operation is backed by forty years' experience in designing and manufacturing quality stokers with outstanding advantages.

- Every Canton Stoker is mechanically designed and engineered to give the highest possible operating efficiency for the specific installation in which it will be used.
- All component parts of Canton Stokers are made of the finest materials—designed, manufactured, assembled, and tested under the rigid Canton "quality-production" policy.
- Canton manufactures 54 types and sizes of Ramfeed and Wormfeed Stokers to supply a broad range of application requirements. Ramfeed Stokers are equipped with either single or double side-dumping Ash Plates. Wormfeed Stokers are supplied in either dead-plate or side-dumping types.
- Canton maintains a complete stoker service and parts organization, available any time, anywhere to assure operators a minimum of "down-time" for their stoker equipment.

In addition, the "plus" advantages of substantial fuel and labor savings made possible with Canton Stokers will demonstrate why thousands of users are "sold" on Canton Ramfeed and Wormfeed Stokers for all types of power generating and heating plants.

CANTON STOKER CORPORATION
Andrew Place, S. W., Canton, Ohio
CANADIAN REPRESENTATIVE: Volcano Ltd., 743 Mountain Street, Montreal 3, Quebec
EXPORT DIVISION: W. B. Harkins, 751 Drexel Building, Philadelphia 6, Pa.

For detailed information on Canton Stokers, call or write the Canton Stoker representative nearest you or Canton Stoker Corporation, 741 Andrew Place, Canton 1, Ohio. *Bulletins on Request.*

Overhead-feed installation of three CANTON Vulcan Ramfeed Stokers at the Magnavox Company, Fort Wayne, Indiana.

CANTON Lo-Set Stoker with Uniflex Drive showing Synchronized Combustion Control connections, Victor Silk Hosiery Mills, Doylestown, Pa.

Battery of four CANTON Duraflex Wormfeed Side-Dump Stokers at U. S. Post Office, Buffalo, New York.

CANTON RAM FEED STOKER DRIVE MECHANISMS ARE GUARANTEED FOR FIVE YEARS

STOKER

CANTON STOKER CORP. CANTON 1, OHIO

1500 Pounds at 1000°F.

Vogt

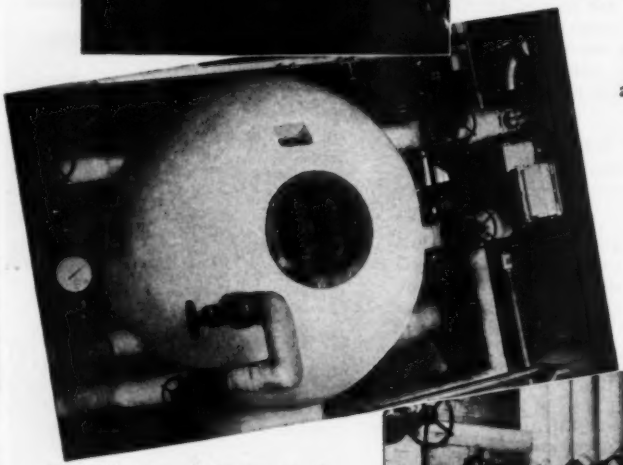
DROP FORGED STEEL

CHROME-MOLY STEAM VALVES

Hold the line at...

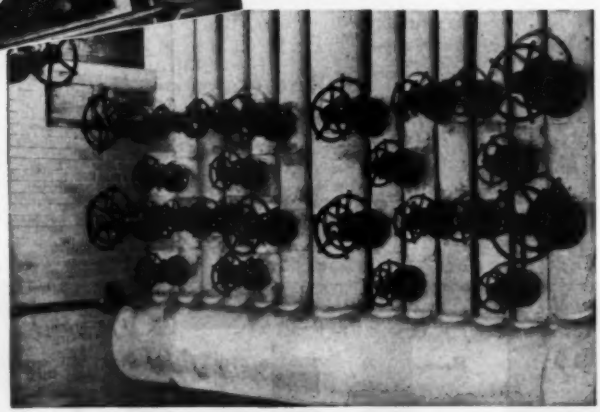
Oswego, N. Y. Station of

* NIAGARA MOHAWK POWER CO.



Leading central stations know and trust Vogt drop forged steel chrome-moly valves in their toughest high pressure and high temperature services.
Specify Vogt . . . and be SURE!

**The Huntley Station at Buffalo and Dunkirk Station at Dunkirk, N. Y. use many Vogt valves.*



TOP: Air view of Oswego, N. Y. Station of Niagara Mohawk Power Co.

CENTER: Valves on main drum of 875,000 pounds per hour steam generator.

RIGHT: Drains from main steam, attemperator, and superheater lines employ a maze of valves.

NEW CATALOG F-9
Consult its 400 pages for the complete Vogt line of drop forged steel Valves, Fittings and Flanges for steam, water, oil, gas, air and refrigeration services.

HENRY VOGT MACHINE CO., Louisville 10, Kentucky

BRANCH OFFICES: NEW YORK, PHILADELPHIA, CLEVELAND, CHICAGO, ST. LOUIS, DALLAS, CHARLESTON, W. VA.

Boilers at Bendix-Westinghouse

Protected with

DREW

COMPLETE BOILER WATER TREATMENT

The Bendix-Westinghouse plant at Elyria, Ohio, is a show place of modern industry. Its facilities, from production machinery to power plant equipment, are new and modern—everything reflecting the company's slogan: "The Best Brake is Air—The Best Air Brake is Bendix-Westinghouse."

Modern boiler water treatment and corrosion control play an important part in this plant, too. The boilers, operating at 400 psi., are protected by Drew Complete Boiler Water Treatment. The steam and condensate return lines are protected by Drew Steam Line Corrosion Control. Better power plant operation is assured by the Drew 3-point program:

1. Drew engineers make thorough studies of boiler plant operations and water conditions.
2. Drew water chemists and engineers analyze this data in Drew laboratories and make specific recommendations for treatment.
3. Drew engineers make frequent tests in the plant to assure efficient performance of the water conditioning.

Thoroughness of investigation, proper treatment and frequent service have made Drew one of America's fastest growing water treatment companies. Industry's most respected names avail themselves of Drew Boiler Water Treatment and Service. Do the same. Consult the nearest Drew engineer or write for information.

Send for new illustrated DREW ORGANICS folder describing the use of organics in modern boiler water treatment. Write today.

POWER DREW CHEMICALS

Power Chemicals Division

E. F. DREW & CO., INC.

15 East 26th Street, New York 10, N. Y.

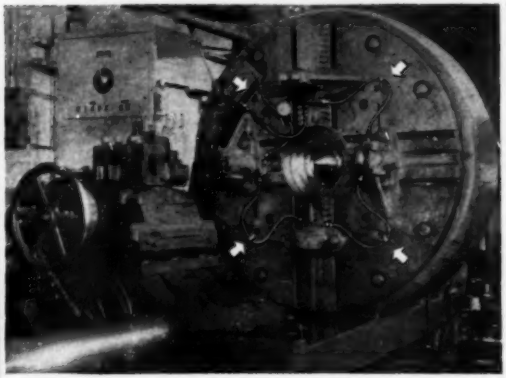
Nationwide Service in Boiler Water and Cooling Water Conditioning

DREW PRODUCTS

Hints for making your products "flexible"

Here are three widely diverse and totally unrelated products. Yet each is made more useful, more versatile with the help of American Flexible Metal Hose or Seamless Tubing.

For piping or ports that move, vibrate or are out of alignment; for carrying almost any liquid, gas or semisolid under high temperatures or pressures, there's a type of American Flexible Metal Hose or Seamless Tubing for the job. You'll be interested in Bulletins SS-50 and CC-300 with technical details and many application histories. Send for them today. The American Brass Company, American Metal Hose Branch, Waterbury 20, Conn. In Canada: The Canadian Fairbanks-Morse Company, Ltd. 51286



LATHE CHUCK

This giant lathe chuck holds railroad car wheels. To exert equal pressure on the wheel rim, five sets of American Seamless Bronze Flexible Tubing carry hydraulic fluid to each of the five driving dogs. This is a typical example of the combined strength, tightness and flexibility which characterize American Flexible Metal Hose and Tubing. Photo courtesy Wm. Sellers & Company Division, Consolidated Machine Tool Corporation, Rochester, N. Y.

EYE EXTENDER

Here's a handy gadget for oil burner and air conditioning installers and repair men—an inspection mirror on a flexible arm utilizing American 7/32" Flexible Steel Tubing. Adjusts to any position of the familiar "gooseneck" lamp arm, for which millions of feet of this American Lamp Arm Tubing have been used. Photo courtesy Eddington Metal Specialty Company, Eddington, Pa.

OIL CONVEYOR

Here's a rough, tough job for American Flexible Metal Hose—transferring heavy road oil from tank truck to sprinkler. Naturally, this service calls for dependable performance under conditions of abrasion, abuse, corrosion, chemical attack and exposure to elements.

wherever connectors must move . . .

ANACONDA

American **FLEXIBLE METAL HOSE AND TUBING**

Every Minute Meant a $1920 saving

Big return for a minute's time . . . but to a leading Philadelphia manufacturer* a 5 minute interview did result in a total saving of $9600.

This manufacturer faced a problem that's common to many plants today. His ten machines have 560 bearings—560 bearings that must be kept lubricated if production is to be kept uniform, rejects few. That lubrication job was taking four man hours every week and, because of human fallibility, there was always the potential danger that one of these many bearings had been overlooked or under lubricated.

An Alemite Lubrication Engineer was called in. He made his presentation in just 5 minutes—5 minutes that saved $9600. He told the manufacturer the facts of installing a modern Alemite Centralized Lubrication System. That system is in the plant today. The result: assurance of continuous, correct lubrication, few rejects and shut downs, and the addition of a whole hour's production time every working day.

Call Your Alemite Lubrication Engineer

No matter what size or type of plant you operate, Alemite can show you dozens of ways to save through the more efficient handling of petroleum products. Call your local Alemite Industrial Distributor now or send for the free booklet "11 Ways to Cut Production Costs." Simply attach the coupon below to your letterhead. Dept. M-101, 1850 Diversey Parkway, Chicago 14, Illinois.

*Name on request.

ALEMITE

MEANS EVERYTHING FOR LUBRICATION

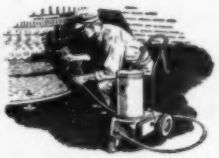
1. Methods 2. Lubricants 3. Equipment

Another Product of Stewart-Warner

Alemite Cuts Costs 3 Ways

1. In transferring lubricants... cuts man hours 63% for every 100 pounds transferred. No mess, no contamination.

2. In loading grease guns . . . saves 3¾ man hours for every 100 pounds of lubricant loaded into hand guns.



3. In applying lubricants . . . saves up to 23.9 man hours for every 100 pounds of lubricant applied to bearings.

FREE! Valuable booklet—
"11 Ways to Cut Production Cost"
(Simply attach to your letterhead)
ALEMITE, Dept. M-101
1850 Diversey Parkway, Chicago 14, Ill.

We'll include facts on the new Alemite Oil-Mist System, too—(OIL-MIST atomizes oil into mist, circulates it to bearings under pressure. Increases life of bearings as much as 17½ times).

Name .....

Company .....

City ..... State .....

For Many Services

...Use this same

FORGED GATE VALVE

CHAPMAN LIST 960

...In these different alloys

- Carbon steel forgings with stainless steel (12-14 chrome) trim.
- Stainless steel (12-14 chrome) forgings with stainless steel (12-14 chrome) trim.
- Stainless steel (18-8) forgings and stainless steel (18-8) trim.
- Alloy steel (4-6) chrome body forgings with stainless steel (18-8) or Cyclops trim.

To all the many jobs for which it's qualified, Chapman List 960 brings *extra* wear-resistance in exclusive features like these:

Extra strength of stem-and-wedge gate connection provides protection against even unusual service stress.

Super-hardened seat rings and wedge-faces of stainless steel.

Bolted Follower with no follower threads on yoke to corrode. Follower easily tightened down any time when necessary.

List 960 comes in sizes from ¼" to 2". Joints either gasketed or metal-to-metal. Two types: Rising stem with yoke (shown), or rising stem with inside screw. Pressure range: 2000 lb. at 100°F.—380 lb. at 1000°F. (For higher pressures, specify List 990.) Send for illustrated bulletin on List 960.

The CHAPMAN Valve Manufacturing Company

INDIAN ORCHARD, MASSACHUSETTS

How to INCREASE BOILER RATINGS with your present furnace and stack

Coppus-Dennis FANMIX Burners Give You More Heat with No Other Major Change in Equipment

Coppus-Dennis **FANMIX** Burners give you *perfect* mechanical mixing of fuel and air *at the burner outlet . . . instantaneous* ignition close to the burner . . . and *complete* combustion *without visible flame* when burning natural gas. No other burner combines these three advantages.

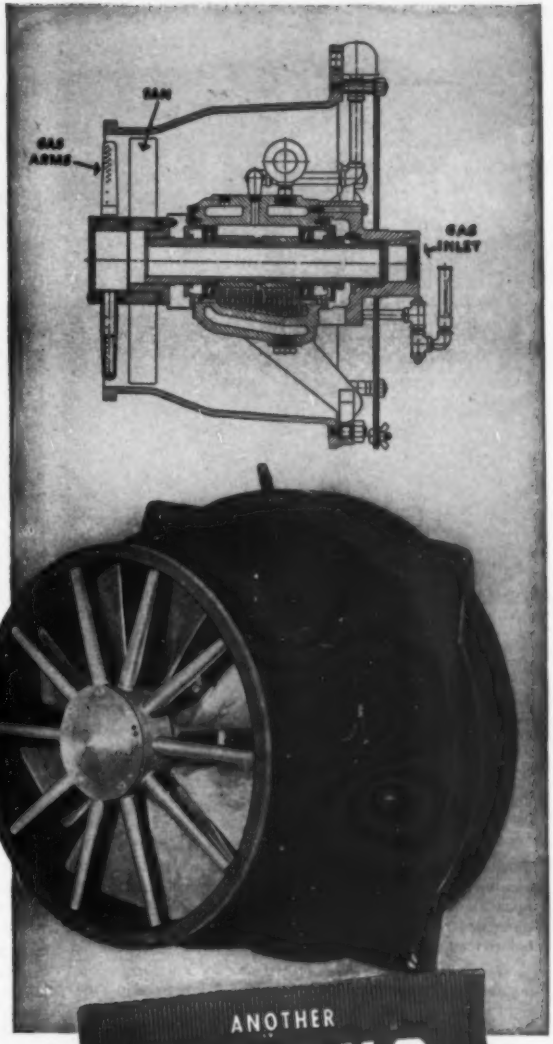
Because **FANMIX** delivers the *right* mixture of fuel and air *without blow-torch action*, all of your furnace space is used for combustion . . . *none for mixing*. That's why your present furnace can release more heat . . . why new installations can get more heat out of smaller furnace space.

Because **FANMIX** can be guaranteed to secure complete combustion of natural gas *with less than 5% excess air*, you get uniform "radiant heat" *without drifting hot spots*. That's why a **FANMIX**-fired furnace seldom varies in temperature more than 5% over its entire area.

WRITE FOR ALL THE FACTS

When you see in Bulletin 410-6 how fuel escaping from orifices in rotating driver arms rotates the fan to draw the correct proportion of air into the path of the fuel at right angles . . . how **FANMIX** creates its own forced draft, reduces stack requirements, prevents cracking of "wet" gas . . . how two **FANMIX** types handle either gas or oil or any combination of both — you'll understand why **FANMIX** Burners have such wide acceptance in oil refineries and power plants.

Send for the Coppus-Dennis **FANMIX** Bulletin 410-6. Coppus Engineering Corporation, Worcester 2, Mass. Sales Offices in THOMAS' REGISTER. Other Coppus "Blue Ribbon" products in BEST'S SAFETY DIRECTORY, CHEMICAL ENGINEERING CATALOG, and REFINERY CATALOG.



ANOTHER
COPPUS
"BLUE RIBBON" PRODUCT

COPPUS ENGINEERING CORP.
190 Park Ave., Worcester 2, Mass.
Please send Bulletin 410-6 to:

Name .....

Company .....

Address .....

Door Blanketing, Food Processing, Tool Storage, Pottery Drying

Trane Air Conditioning Serves Everywhere in Industry

The right answer for any factory heating, ventilating or air conditioning problem – you'll find it in the Trane line, just as thousands of others have –

Door Blanketing – Drafty shipping rooms are a frequent hurdle to effective factory heating. One midwest steel manufacturer found a neat answer in Trane Projection Heaters. Installed at the ceiling, the units focus warmth at the shipping room doorway and at other critical spots, blocking drafts before they start.

Food Processing – A New Orleans food processor demanded two things of the air in his plant—it had to be just the right temperature and humidity the year-around; it had to be filtered. A complete air conditioning system, with Trane Climate Changers and Trane Compressors, meets both demands.

Tool and Gauge Storage – Gauge accuracy, guarded by closely controlled temperatures and humidity, was a must for a midwest bearing manufacturer. Trane Heating and Cooling Coils, Trane Centrifugal Fans and a Trane Compressor provide these conditions in the gauge and tool storage room.

Pottery Drying – When vases and ceramic statues dry, the process must be even and gradual. Hot streams of air or direct blasts from a heater make for uneven drying and cracked pottery. That's why a pottery maker in Illinois uses Trane Horizontal Unit Heaters and Louver Fin Diffusers to hold drying room temperatures even, constantly.

Area Heating – A sprawling plant and a huge open machine shop meant a big heating job in an eastern **airplane** factory. Trane Torridors, hanging at the ceiling, send a lot of Btu's a long way, so the shop is comfortable and production is humming.

Whatever your heating, cooling, ventilating or air conditioning problem is, look for the answer in the complete Trane line.

Tool Storage—Trane air conditioning keeps temperatures constant, delicate tools, gauges accurate.

Pottery Drying – Diffused heat from Trane Unit Heaters and Diffusers solves another drying problem.

Area Heating – A lot of heat sent a long way — Trane Torridor handles the big heating jobs easily.

TRANE

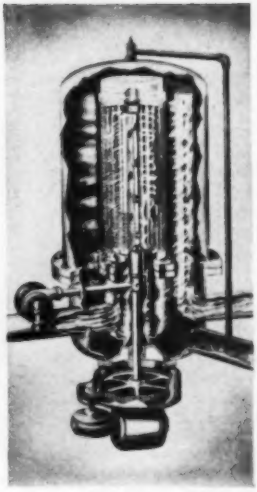
MANUFACTURING ENGINEERS
OF HEATING, VENTILATING AND
AIR CONDITIONING EQUIPMENT

THE TRANE COMPANY, LA CROSSE, WIS.
Eastern Mfg. Division . . . Scranton, Pennsylvania
Trane Company of Canada, Ltd. . . . Toronto
OFFICES IN 80 U. S. and 14 CANADIAN CITIES

Clean Raw Water
Reclaim Process Water

with this low-cost non-stop strainer

Abrasion and corrosion-resistant Cuno FLO-KLEAN handles full flow—cleans itself and discharges accumulated trash *without interrupting* flow. Can be installed in some remote place and forgotten. Some users have saved enough to pay cost of FLO-KLEAN in a few months!



CUNO

Fluid Conditioning

Removes More Sizes of Solids from More Kinds of Fluids

Strain fuels, lubricants, process fluids, etc.—AUTO-KLEAN
Filter fuels, lubricants, process fluids, etc.—MICRO-KLEAN
Clean raw water, recirculating water, etc.—FLO-KLEAN

Aid for "Dry" Communities ... Relief from High Water Bills

Many industrial plants have solved the scarce-water problem by using raw river or lake water for plant services.

Passing such water through a Cuno FLO-KLEAN effectively strains out trash and cleans the water at rates up to 20,000 gpm, with negligible pressure drop.

Other plants use FLO-KLEAN for reclaiming used process water. Even when water isn't scarce, it still costs money, particularly if it has been heated for process work.

On this basis, Cuno FLO-KLEANS have paid for themselves in as short a time as six months.

They even reclaim their own backwash water—not wasting a drop!

Continuously Cleanable Permanent

The Cuno FLO-KLEAN positively removes all solids larger than specified. May be specified from .030 in. down to .0025 in. Operation is continuous—because the strainer is continuously self-cleaning. Therefore, full flow can be handled without needing a duplex installation.

With continuous backwash cleaning of the cartridge and automatic top and bottom blow-down, the FLO-KLEAN needs no attention.

All-metal construction is abrasive and corrosion-resistant.

Cuno Engineering Corporation
Dept. 141E, South Vine Street, Meriden, Conn.

Please send information on Cuno FLO-KLEAN for straining raw water....reclaiming process water....

Name.....Title.....

Company.....

Address.....

City.....Zone....State....

Please attach to business letterhead

Door Blanketing, Food Processing, Tool Storage, Pottery Drying

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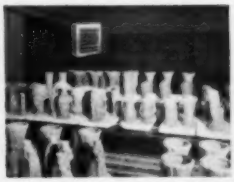

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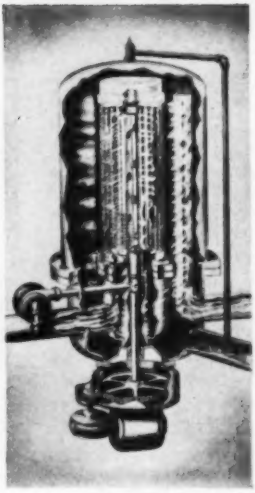
OFFICES IN 80 U. S. and 14 CANADIAN CITIES

Clean Raw Water
Reclaim Process Water

with this low-cost non-stop strainer

Abrasion and corrosion-resistant Cuno FLO-KLEAN handles full flow—cleans itself and discharges accumulated trash *without interrupting* flow. Can be installed in some remote place and forgotten. Some users have saved enough to pay cost of FLO-KLEAN in a few months!



CUNO

Fluid Conditioning

Removes More Sizes of Solids from More Kinds of Fluids

Strain fuels, lubricants, process fluids, etc.—AUTO-KLEAN
Filter fuels, lubricants, process fluids, etc.—MICRO-KLEAN
Clean raw water, recirculating water, etc.—FLO-KLEAN

Aid for "Dry" Communities ... Relief from High Water Bills

Many industrial plants have solved the scarce-water problem by using raw river or lake water for plant services.

Passing such water through a Cuno FLO-KLEAN effectively strains out trash and cleans the water at rates up to 20,000 gpm, with negligible pressure drop.

Other plants use FLO-KLEAN for reclaiming used process water. Even when water isn't scarce, it still costs money, particularly if it has been heated for process work.

On this basis, Cuno FLO-KLEANS have paid for themselves in as short a time as six months.

They even reclaim their own backwash water—not wasting a drop!

Continuously Cleanable Permanent

The Cuno FLO-KLEAN positively removes all solids larger than specified. May be specified from .030 in. down to .0025 in. Operation is continuous—because the strainer is continuously self-cleaning. Therefore, full flow can be handled without needing a duplex installation.

With continuous backwash cleaning of the cartridge and automatic top and bottom blow-down, the FLO-KLEAN needs no attention.

All-metal construction is abrasive and corrosion-resistant.

Cuno Engineering Corporation
Dept. 1418, South Vine Street, Meriden, Conn.

Please send information on Cuno FLO-KLEAN for straining raw water....reclaiming process water....

Name.....Title.....

Company.....

Address.....

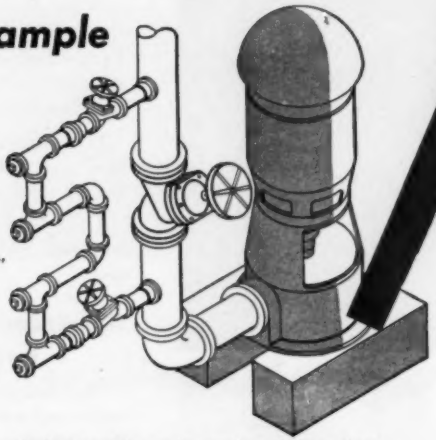
City.....Zone....State....

Please attach to business letterhead

for outstanding service

on Corrosive Well Water

...for example



The Installation—
Barr Rubber Products Co.,
Sandusky, Ohio

PROBLEM: To eliminate costly seating and packing maintenance, and frequent replacement of valves on plant well-water pump. Valves previously used highly unsatisfactory, having maximum life of 6 months.

WORKING CONDITIONS: Sulphur content of water extremely high. Valve constantly exposed to severe corrosive and erosive effects. Operated infrequently; yet easy operation, positive seating are prime requisites.

SOLUTION TO PROBLEM: Crane Packless Iron Body Diaphragm Valves featuring separate disc and diaphragm design. Three-inch No. 1611 flanged end valve on main discharge; ¾-inch No. 1610 screwed end valves on by-pass.

RESULT: While other valves lasted only 6 months or less, Crane Diaphragm Valves show no effects of service, after more than a year. They operate smoothly . . . seat tightly . . . no maintenance whatsoever needed to date!

Another typical demonstration of superior quality, and the low-cost performance of Crane Valves. That's why . . . More CRANE VALVES are used than any other make!

...Choose Dependable CRANE VALVES

No. 1611 Crane Iron Body Diaphragm Valve —one of a full line suited for many services. Literature on request from your Crane Branch or Crane Wholesaler.

CRANE CO.

General Offices:
836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

B.F.Goodrich GROMMET BELTS AT WORK

This giant barrel is loaded with hides soaking in an acid bath. It's the first step in making a pair of shoes.

First step to pair of shoes

New hides are dumped into that drum, with acid, and tumbled round and round for hours. Four rubber V belts on each side of the barrel do the work. But turning that 8-foot barrel full of heavy hides put a terrific strain on the belts. They would wear out in only four months. Then the whole process was stopped. No way to get a shoe to market. An entirely new kind of belt was needed. See the following pages to find out how this problem was solved.

Tumbling barrel (continued)

The belts on this drive are under terrific tension turning the big rough-surface barrel shown on preceding page.

The problem described on preceding page was solved by a B. F. Goodrich man for the Hartland Tanning Co. of Hartland, Maine. He recommended that the short-lived belts be replaced with B. F. Goodrich grommet belts. BFG grommet belts *look* the same as ordinary V belts but, because of an entirely different construction principle, grommet belts carry heavier loads, stand more shocks, and last longer than ordinary belts. On this drive, BFG grommet belts are averaging 10 months —2½ times as long as the former belts.

20 to 50% Longer Life

Patented grommet belts by B. F. Goodrich represent the only basic improve-

ment since invention of the V belt. Belts last 20 to 50 per cent longer, depending on service. (The more severe the service the greater the increase over ordinary belts.)

What is a Grommet?

A grommet is like a giant cable except that it's *endless*—a cord loop built up by winding heavy cord on itself. There is no overlapping cord *section* as in all ordinary belts. Most belt failures occur in these sections where cords overlap!

All Cords Put to Work

Each grommet and every part of a grommet carries its share of the load. In ordinary belts under high tension the center cords "dish" because tension is greater near the driving faces. Dished cords are doing less work, not pulling their share. Grommet belts have no center cords, there is no dishing—therefore much more strength in proportion to cord volume.

Better Grip, Less Slip

Grommet belts have more rubber in relation to belt size. Without any stiff overlap, they're more flexible, grip pulleys better. Size for size, grommet belts give ⅓ more gripping power, pull heavier loads with a higher safety factor. Because there is less slip, there is also less surface wear.

They Cost No More

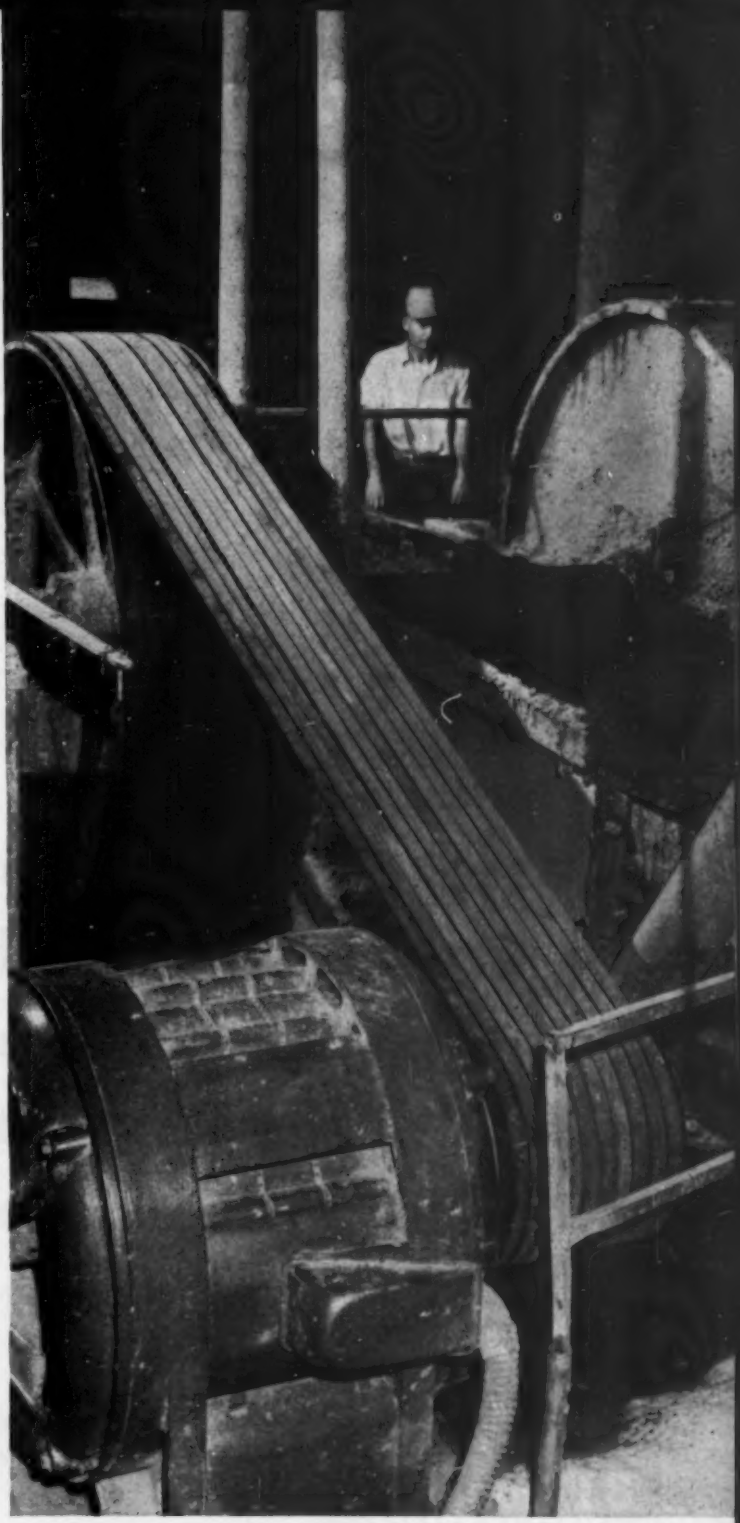
You save belt costs because belts last longer, save production costs because machines keep running with fewer interruptions, save maintenance costs because they need less attention, yet cost not one cent more than others. Grommet belts are made in C, D and E sections. They are patented by B. F. Goodrich. No other V belt is a grommet belt (U. S. Patent No. 2,233,294).

See "X-ray" Belt

A special demonstrator "X-ray" belt has been made to show the grommet construction. Ask your local B. F. Goodrich distributor to show it to you.

Pulp beater ➧

This drive works 24 hours a day, 7 days a week at Tamko Asphalt Products, Inc., Joplin, Mo., furnishing power to a pulp beater that shreds the basic material for roofing. These B. F. Goodrich grommet belts have been running constantly for three years without losing a single minute due to belt trouble.



B.F.Goodrich GROMMET BELTS AT WORK

Saved $100 a week

What would you do if you were spending a $100 a week to replace failing V belts on one drive? That was the case in this mill—ordinary V belts failed in a week or less. They couldn't carry the terrific power load.

The company called in a BFG sales engineer and B. F. Goodrich grommet V belts were installed. That was 5 months ago and the grommet belts look as good today as the day they were put on.

Other users' experiences confirm this:

"The belts we had been using lasted 5 or 6 weeks . . . B. F. Goodrich grommet belts are in their sixth month of service."

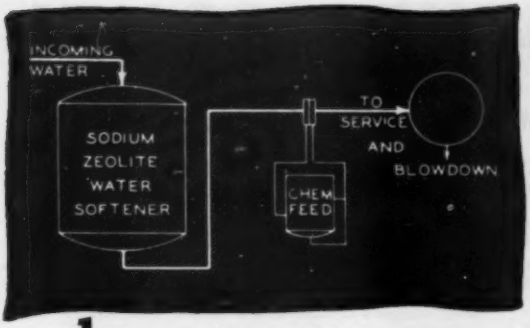
"Previous belts suffered from shock loads, wore out fast . . . BFG grommet belts have been in service 2 years with no shut-downs . . ."

BFG belts solved shutdown problem.

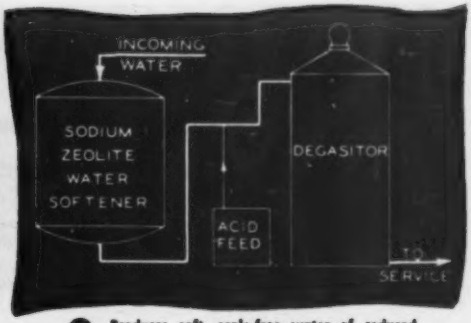
These typical examples tell you why B. F. Goodrich grommet belts are superior to ordinary V belts. They prove that grommet belts last 20 to 50% longer than other types—yet cost no more.

Grommet V Belts BY
B.F.Goodrich
FIRST IN RUBBER

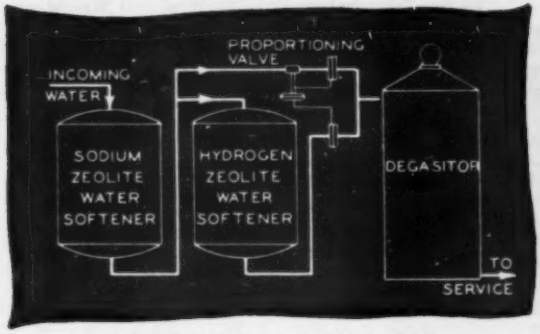
The B. F. Goodrich Company, Industrial Products Division, Akron, Ohio



1 Gives soft, scale-free water — prevents corrosion.



2 Produces soft, scale-free water of reduced alkalinity.



3 Delivers soft, scale-free water. Reduces alkalinity to desired level and gives marked reduction in total dissolved solids.

4 Produces deionized water of highest known chemical purity. Removes CO_2, silica, and all ionizable solids.

Four ELGIN Ways . . .

to Control Dissolved Solids and Alkalinity of Boiler Feed and Process Water

With 43 years of experience in the design and manufacture of water conditioning equipment, Elgin is qualified to provide exactly the type of water conditioning system best suited to your specific needs.

This is well illustrated by the four typical ion exchange systems diagramed above which deliver water "tailored" to the specific requirements of any boiler plant or processing operation. It will pay you to study these diagrams one by one.

In many cases a zeolite water softener supplemented by chemical treatment (diagram 1) will deliver water of suitable quality for the purpose at low cost.

Where soft, scale-free water of reduced alkalinity is required, zeolite softening plus acid feed and degasification (diagram 2) is the economical answer for many water supplies.

Should a marked reduction in total dissolved solids also be desired, blended sodium and hydrogen zeolite softened water plus degasification (diagram 3) will best do the job.

For the highest quality water known today, the Ultra-DeIonizer (diagram 4) is the ultimate in water conditioning. This remarkable single-tank unit which contains mixed anion and cation exchange resins, delivers chemically pure water, free of silica and CO_2 at an amazingly low cost.

Yes, these are typical examples of the broad scope of Elgin water conditioning. One of our engineers will be glad to study your conditions and lay out a "tailored" system which will best fit your need and budget — permanently solve your water problem. Write us today.

ELGIN
Economical
WATER CONDITIONING
FOR EVERY NEED

ELGIN SOFTENER CORPORATION

138 N. Grove Ave., Elgin, Ill.

Representatives in Principal Cities

"K" MONEL and "KR" MONEL

Age-hardenable, non-magnetic alloys offering high strength, excellent corrosion-resistance and good working properties

Where stressed structural members must be placed close to sensitive electro-magnetic equipment, or where extra strength is needed in corrosive environments, these Inco Nickel Alloys offer solutions to the problems of metal selection.

Both alloys show *improved* strength and hardness at sub-zero temperatures. And both alloys provide moderate strength at temperatures to 900°F.

"K"® Monel and "KR"® Monel are similar in composition and properties. "KR" Monel has better machinability and is recommended for parts requiring intricate machining.

The principal engineering characteristics of these alloys are:

Tensile Properties: "K" Monel in the fully age-hardened condition has a minimum yield strength (0.2% offset) of 100,000 psi and a tensile strength of over 140,000 psi, with minimum elongations (in 2 in.) of 15% and 20% for cold-drawn and hot-rolled materials respectively. "KR" Monel, age-hardened, has a minimum yield strength (0.2% offset) of 90,000 psi with minimum elongation of 20% (in 2 in.) for as-rolled material.

Shear Strength: The shear strength of "K" Monel, as determined with .050-in. x .250-in. specimens subjected to double shear, is (full hard, age-hardened) 98,450 psi maximum, with 0.04 in. deflection. The shear strength of "K" Monel rivets, fully age-hardened, is 89,200 psi with ultimate tensile strength of 147,000 psi.

Spring Properties: "K" Monel wire can be cold-drawn and age-hardened to develop 160,000 to 200,000 psi tensile strength. The torsional proportional limit of cold-drawn, age-hardened wire is about 40% of the ultimate tensile strength.

Endurance Limit: In rotating beam tests of polished specimens at room temperature and 10,000 r.p.m., "K" Monel (cold-drawn, age-hardened) showed an endurance limit for 10^8 cycles of 41,000 to 59,000 psi.

Magnetic Characteristics: "K" and "KR" are non-magnetic under ordinary conditions and remain so at sub-zero temperatures.

Working Characteristics: Both "K" Monel and "KR" Monel may be hot-worked, forged, and cold-worked. "K" Monel may be readily machined in the annealed condition and may be considered commercially machinable at practical rates in other conditions with Brinell hardness of up to 275. "KR" Monel, because of higher carbon content and special thermal treatment, has better machinability than "K" Monel and is recommended for parts requiring more intricate machining. Because of greater hardness, both alloys will take a higher polish than Monel. Both may be joined by the usual welding, brazing, and soldering processes.

Corrosion Resistance: These alloys are highly resistant to attack by most commonly-encountered corrosives, including mineral and organic acids, alkalies, salts, potable and industrial waters, foods, organic compounds, and oxidizing atmospheres at normal and elevated temperatures.

Forms Produced: "K" Monel is supplied in most commonly-used mill forms—rods, hexagons, squares, flats, strip, sheet, seamless tubing, wire, welding materials—and in a variety of finishes and conditions. "KR" Monel is produced in rods, hexagons, squares, hot-rolled and cold-drawn.

Applications: Because these alloys retain their non-magnetic, corrosion-resistant, and high physical qualities at abnormal temperatures, they have been used to advantage in aviation instruments, roller chains for retractable landing gear, controls, springs and contact arms in electrical equipment, in stressed structural members and fastenings.

"K" MONEL

Effect of temperature on physical properties
(Age-hardened condition)

Test Temperature °F.	Yield Strength (0.20% offset) psi.	Tensile Strength psi.	Elongation in 2 in. per cent	Creep Strength (0.10% in 10,000 hr.) psi.	Hardness (Brinell)	Impact (Charpy) ft.-lb.
−300	160,200	202,000	27	...	...	...
−110	134,600	171,550	17.3	...	36 (Rock. C)	27
Room	111,000	160,000	23.5	...	331	27
200	108,000	150,000	23.5	...	...	...
400	103,000	149,000	24	...	...	...
600	105,000	146,000	23	...	...	...
750	...	...	...	67,000	...	...
800	105,000	124,000	8.5	48,000	302	...
1000	92,000	95,000	3	8,500	255	...
1100	...	...	...	...	229	...
1200	80,000	80,000	1.5	...	...	...
1400	30,000	45,000	8	...	...	...

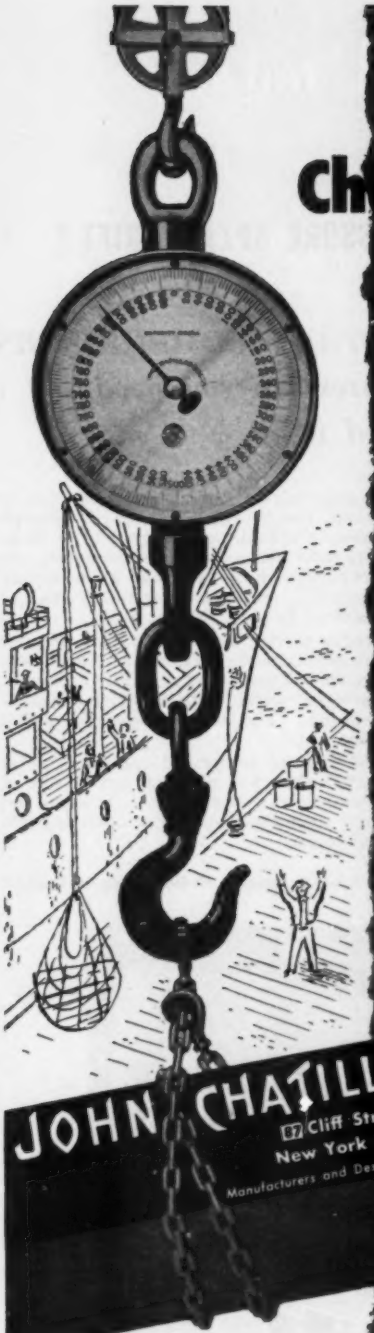
FURTHER DATA AVAILABLE

A 23-page reference manual, *Engineering Properties of "K" Monel and "KR" Monel*, contains all essential engineering information on these alloys. It is available, free, for your files.

Nickel alloys are being increasingly diverted to defense applications. However, technical help for metal problems involving corrosion, high temperatures or fatigue is available from INCO's Technical Service, either for immediate defense needs or for future installations.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

EMBLEM OF SERVICE
NICKEL (INCO) ALLOYS



Chatillon Crane Scales

are engineered for faithfully accurate heavy duty weighing!

These remarkable spring-type, direct reading and large capacity Chatillon Crane Scales are engineered to withstand rugged service that would ruin other types of weighing apparatus.

Built for 1,000 to 10,000 capacities, each scale is equipped with two special alloy steel springs, precision calibrated and designed for maximum safety. Virtually indestructible, every Chatillon Crane Scale has a recoil mechanism which protects the rack and pinion against sudden shock; a recessed dial to protect pointer; large easy to read aluminum dial with black graduations and figures, and cases made of malleable iron, with top and bottom rings drop forged. Lightweight and less cumbersome, a 5,000 lb. Chatillon Crane Scale weighs only 93 lbs.

REMEMBER: *John Chatillon & Sons will design and manufacture scales and other measuring devices to meet your particular needs.*

Cat. No.	Cap. Lbs.x Lbs.	Ship Wt.
10-10000	1000x5	50
10-10000	1000x5	79
13-20000	2000x5	78
15-50000	5000x10	93
16-100000	10000x25	240

Weights given above are shipping weights. To order Crane Scale with Hook, add letter H to Catalog number, i.e.: 10-1000DH, 13-2000DH, etc.

JOHN CHATILLON & SONS
87 Cliff Street
New York 7, N. Y.
Manufacturers and Designers of Precision Instruments Since 1835

Fill In and Mail Coupon Today

John Chatillon & Sons, 87 Cliff Street, New York 7, N. Y.

Gentlemen: Please send me complete brochures on

- ☐ Crane Scales
- ☐ Laboratory Scales
- ☐ Dynamometers Scales
- ☐ Push Pull Gauges
- ☐ Force Measuring Devices

Name_____ Company_____

Address_____ Position Held_____

WHO, ME, A PRESSURE SPENDTHRIFT?

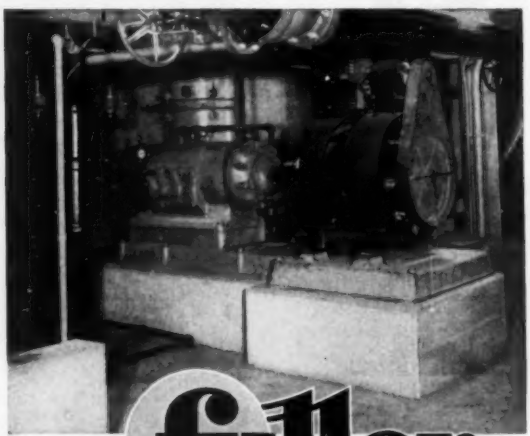
Let FULLER ROTARY COMPRESSORS supply just the pressure you need . . . WHERE you need it.

Sure, you need large, high pressure units to supply pressures equal to the demands of certain operations. But it costs plenty to compress air for these uses . . . and then have to reduce pressure from 10 to 50 lb. for some other task. That's why more and more plants throughout the country have adopted the economical plan of "spotting" Fuller Rotary Compressors wherever air is needed . . . at pressures up to 125 psig . . . supplying *only* the pressure required for most efficient work.

Fuller Rotary Compressors have few moving parts . . . the rotor, bearings and blades. They're fully dependable . . . need only infrequent inspection. There are no valves to leak or seats to grind. They're readily accessible. Blades automatically compensate for wear. ***Full capacity is maintained for the life of the machine.*** They're engineered for a full life-time of new machine efficiency.

If you're interested in dependable, more economical operation, get in touch with a Fuller engineer. He'll show you how you can be sure of getting just the pressure you want, where you want it . . . how you can cut installation and maintenance costs while you boost operating efficiency. There's no obligation, of course.

FULLER COMPANY, Catasauqua, Pa. • 120 S. LaSalle St., Chicago 3 • 420 Chancery Bldg., San Francisco 4



DRY MATERIAL CONVEYING SYSTEMS AND COOLERS
COMPRESSORS AND VACUUM PUMPS
FEEDERS, AND ASSOCIATED EQUIPMENT

fuller

C-197

trying to decide what fuel to use

perhaps Beacon Combustion Service*

can give you some outside information

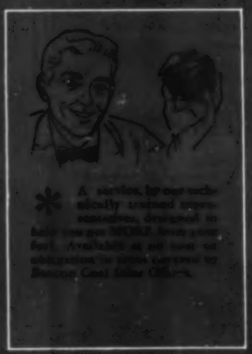
When you're thinking of changing fuels . . . be sure you don't think only of the *disadvantages* of the oil . . . and of the *advantages* of the new. The Beacon Combustion Service Man can be helpful at a time like this . . . with *outside* information that will help you reach a sound decision . . . and maybe save some money in the bargain.

FOR EXAMPLE: Large industrial plant used mixture of two coals for povderized-fuel steel boilers. Had difficulties due to (a) dust from lower-cost coal, and (b) fineness . . . which allowed air feed from pulverizing mill to furnace. Engineers decided to standardize on higher-cost fuel: extra cost 50-cents a ton. B. C. S. Man recommended standardization on cheaper fuel . . . dust treatment (at 15 cents per ton) . . . and adjustment of fan to provide proper feed for the one coal. Net saving—45 cents a ton . . . a potential pick-up of thousands of dollars in this instance.

FOR EXAMPLE: Apartment building contemplated change to liquid fuel, because of smoke problems. B. C. S. Man opened possible or inadequate combustion space . . . which would have caused more smoke problem with new fuel. Fixing either eliminated difficulty, permitted continued use of lower-cost fuel.

It pays to spot the REAL sources of difficulties or dissatisfaction before making any change that involves trouble and expense. The B. C. S. Man will be glad to survey your operations with you, help to pin-point the problem and suggest ways to correct it.

NOTE TO COAL DEALERS: If any of your commercial or industrial customers or prospects have a problem like this, your B.C.S. Man will be glad to work with you in determining the cause—and recommending a solution.



* A service, by our technically trained representatives, designed to help you get MORE from your fuel. Available at no cost or obligation to users surveyed by Eastern Gas and Fuel Associates.

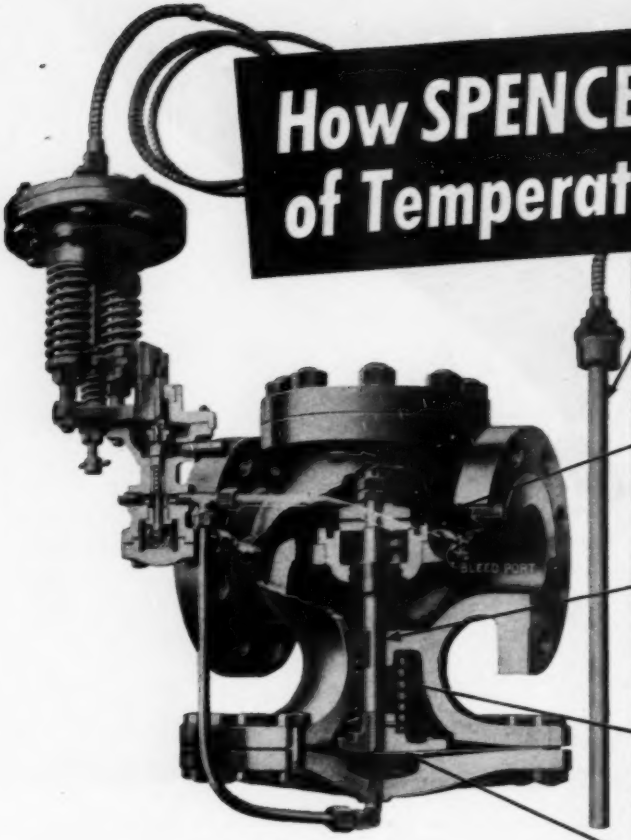
EASTERN GAS AND FUEL ASSOCIATES — BEACON COAL

EASTERN GAS AND FUEL ASSOCIATES

PITTSBURGH BOSTON CHICAGO CLEVELAND DETROIT NEW YORK
NORFOLK PHILADELPHIA SYRACUSE

For New England: New England Coal & Coke Co., *For Export:* Castner, Curran & Bullitt, Inc.

How SPENCE Cuts Costs of Temperature Control



NEW THERMOSTAT ELEMENT—Improved to practically eliminate loss of filling. Rugged construction; cannot be injured by overheating.

SECO METAL—Seats and discs are made of SECO Metal—guaranteed not to wire-draw.

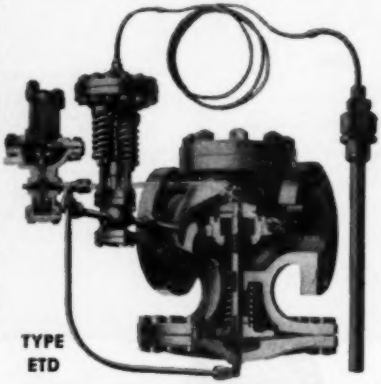
PACKLESS CONSTRUCTION — All Spence main valves and most pilots are built without stuffing boxes. This minimizes friction . . . eliminates much time-consuming maintenance.

PROTECTED SPRINGS — Springs in the Spence Regulator are out of the path of the steam or other fluid flowing through the valve.

LARGE BALANCED DIAPHRAGM— Spence metal diaphragms, under usual conditions, never require replacement.

Accurate Control for Both Storage and Instantaneous Heaters

Spence Temperature Regulators reduce the steam pressure and also accurately modulate the flow as required to control the temperature. No separate reducing valve is necessary • The Spence ET150 Regulator is recommended for heater pressures up to 50 psi. For higher pressures the Type ETD is available • For complete details on the entire Spence line of automatic regulating valves, strainers and desuperheaters, write for Bulletin 1200.

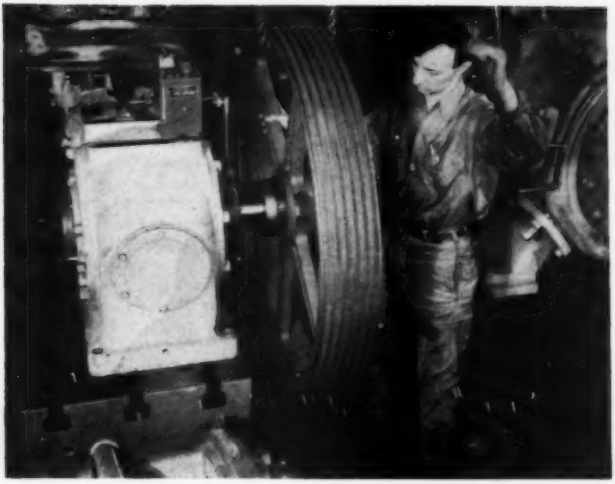


TYPE ETD

SR 111

Spence

SPENCE ENGINEERING COMPANY, INC.
WALDEN, NEW YORK



Pick the V-Belt Sheave

which all industry likes best

QD
TRADE MARK

Split hub is clamped to shaft. Heavier taper-bored rim slides easily over tapered hub—no keyway obstruction on cone surface. Positive press fit on shaft. Large, long pull-up bolts also used as jack screws to remove rim.

Here's a 26-word description of the V-belt sheave that is used more than any other.*

Two parts for easy handling—separately or together. Split hub and taper-mated rim make mounting easy. No re-alignment problem—clamped hub stays put while changing rims.

That's Worthington's QD—the original tapered cone-grip sheave that's preferred by men who have to install or change sheaves. The QD is *easy to get on, easy to get off, yet always tight on the shaft* —tighter than any other sheave on the market. Hubs for every bore—lower inventory cost.

For your machines, pick Worthington Multi-V-Drives with QD sheaves and Worthington-Goodyear EC Cord V-belts.

Complete range of stock sizes—prompt shipment from distributors everywhere.

**In addition to being one of the largest-selling sheaves, the popular Worthington QD design is licensed to many other sheave manufacturers. For your protection, dimensions are standardized to permit interchangeability.*

but the distributor "came through"

A hydro-electric plant, crippled by drought, was threatened with losing its franchise; was given 60 hours to bring its service up. Two Diesel engines were about to arrive when somebody remembered to order the V-belt drives.

A call to **Anderson-Crane Rubber Company**, Worthington distributor in Minneapolis, located four large D-section QD sheaves and 25 Worthington-Goodyear steel cable V-belts. These were rushed by car at night to the power plant, arriving just ahead of the engines. Within 24 hours, the plant was producing full power.

Once again, the Worthington distributor was on *the job*—with the needed supplies and the prompt service!

WORTHINGTON

THE GOOD RIGHT HAND OF INDUSTRY

POWER TRANSMISSION: sheaves, V-belts, variable speed drives

PUMPS: centrifugal, power, rotary, steam

AIR COMPRESSORS: water-cooled, air-cooled

Worthington Pump and Machinery Corporation
Multi-V-Drive Sales Division
Buffalo, New York

Send Bulletin V-1400-B7F on Worthington Multi-V-Drives.

Name .....

Company .....

Address .....Zone....State...

MV.1.3

1.

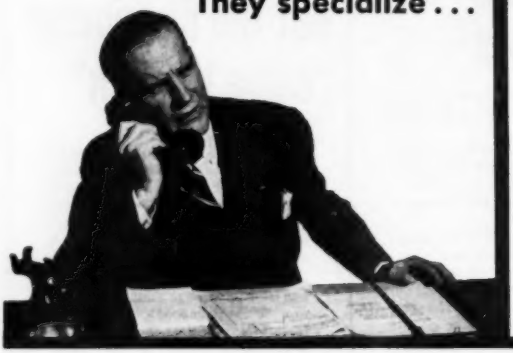
That's right!
I burn No. 6 oil

2.

No, not a bit of trouble!

3.

Yes, it's a Preferred.
They specialize . . .



4.

. . . in fully* automatic operation with residual fuels!

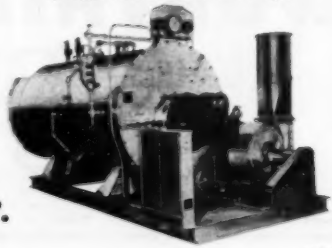
That plant engineer is only one of hundreds who label us specialists in *fully* automatic operation with residual oils. We're proud of the title, of course, for we achieved what many folks said couldn't be done. But, actually, we at Preferred like to be thought of as all-around experts in combustion problems. Witness the complete Preferred line of gas, combination oil-and-gas and light oil-fired steam generators.

We tackled and solved the problem of residual oils, because we knew we could cut your production costs by $3,000 to $35,000 a year by reducing fuel costs. Scores of Preferred customers have already pocketed these savings. Like the engineer on the 'phone, they are burning No. 6 oil with *fully* *automatic operation.

If you are now using more expensive grades of fuel, discuss your installation with a Preferred representative or write for Bulletin 175 about the Preferred Horizontal Rotary Oil Burner and Bulletin 1000 which describes the Preferred Unit Steam Generator.

*What We Mean By *Fully Automatic* Operation

- **Starts *automatically***
- **Ignites *automatically***
- **Starts at low fire and follows load *automatically***
- **Shuts off, cleans and purges itself *automatically*.**



PREFERRED UTILITIES MANUFACTURING CORP.
1860 BROADWAY, NEW YORK 23, N. Y.

PR 206

FOR PART LOADS

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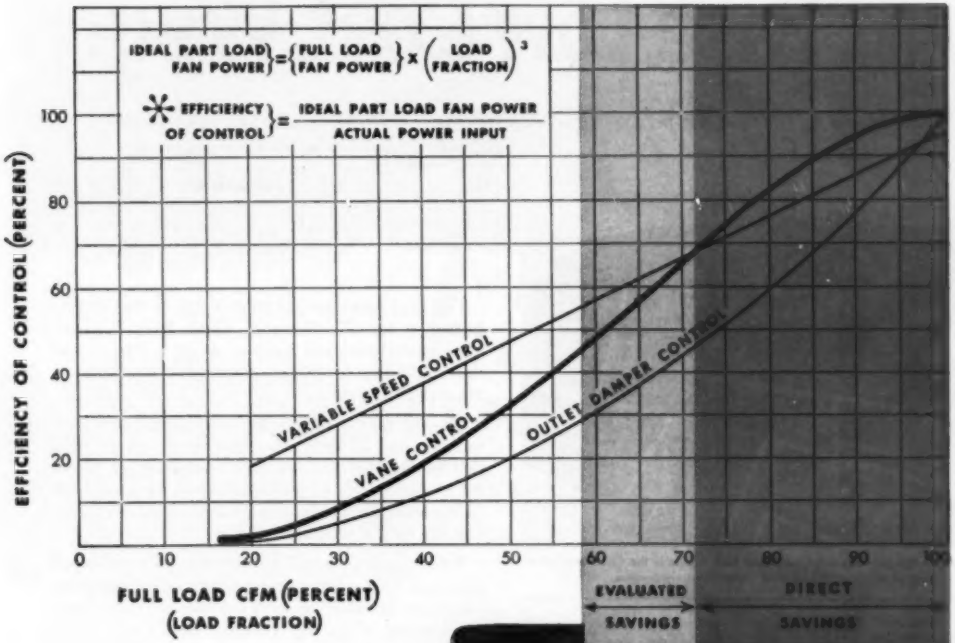

If you operate in this range—and most plants do — VANE CONTROL is the economical choice

Have you ever considered the relative efficiencies of methods of mechanical draft fan volume control—and then evaluated them against first cost? Do so, and you will find Sturtevant Inlet VANE CONTROL is the best. It is high in *efficiency of control** and low in first cost.

Whether for forced or induced draft, the *new* VANE CONTROL is a simple and reliable regulator of fan output—a control which responds instantly to varied demands, and yields major power savings at reduced loads.

A new Bulletin, DB 92-810, describes the mechanical improvements developed for Sturtevant VANE CONTROL and its use in mechanical draft, industrial and ventilating applications. Write today for a free copy. Westinghouse Electric Corp., Sturtevant Division, 158 Damon St., Hyde Park, Boston 36, Mass.

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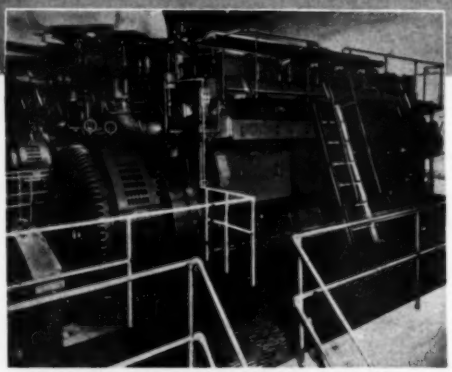
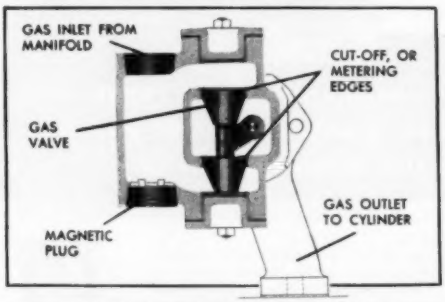
J-80220

They're Handling Expanding Power Loads The Fast, Low Cost Way:

Iowa Utility Company, Like So Many Others, Uses Worthington Dual Fuel Units For Uninterrupted Service On The Cheapest Fuel Available



A Worthington Supercharged Dual Fuel Engine in the Oskaloosa plant — part of the Iowa Power And Light Company System.



WORTHINGTON MICRO-METERING GAS VALVE
One for each cylinder

Used on Spark Ignition and Dual Fuel Engines — Governor controlled — Individually adjusted.

Assures: — Equal cylinder loading — Smooth running at all loads — Better speed regulation — Lower maintenance.

Full load operation, 24 hours a day, is routine performance for Worthington Dual Fuel Engines. They're designed and built to do just that — and they're doing it for power companies in communities all over the world.

They're saving money for their users every day, too, because of their Worthington-pioneered dual fuel feature that enables them to operate on gas or oil, or any combination of these fuels. Also, without losing load, they can instantly be changed over from one fuel to the other.

When gas is your fuel, only a very small amount of pilot oil is needed for ignition. Micro-metering valve (see drawing) on each cylinder provides equal distribution of gas for smooth, steady operation. Supercharging assures maximum economy through high thermal efficiency with either fuel.

BESIDES FUEL SAVINGS—

Lubrication and maintenance costs have been cut to a minimum through an effective system of "hot-spot" lubrication, according to users of Worthington Dual Fuel Engines. Why not get the whole story that proves *there's more worth in Worthington?* Write to *Worthington Pump and Machinery Corporation, Engine Division, Buffalo, New York.*

WORTHINGTON

E1-2

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WORTHINGTON-BUILT AUXILIARIES

Diesel engines, 150 to 3,520 hp . . . gas engines, 175 to 3,520 hp . . . dual fuel engines, 225 to 3,290 hp.

Balanced Angle Compressors

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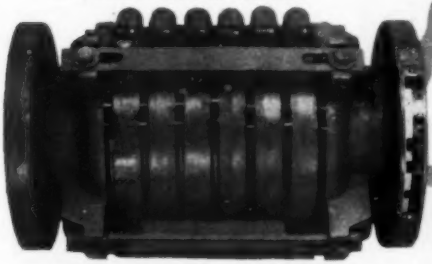
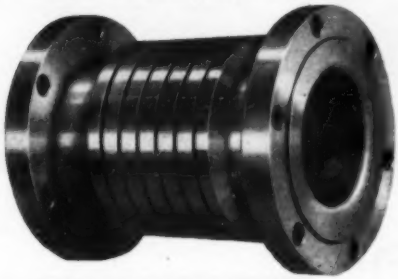
CMH Expansion Joints are preferred by so many piping engineers

- ✓ Space Saving
- ✓ Weight Saving
- ✓ Streamlined Flow
- ✓ Lower Overall Cost
- ✓ Ease of Installation
- ✓ Trouble Free Operation
- ✓ Freedom from Maintenance

CMH Free-Flexing Expansion Joints for pressures to 30 psi; stainless steel or copper; flanges or welding ends; standard sizes to 48" I.D.; larger sizes available for special applications.



CMH Controlled Flexing Expansion Joints for pressures to 300 psi; stainless steel or copper; flanges or welding ends; sizes to 48" I.D.



CMH Flexoniflex Expansion Joints with integral control rings for pressures to 5500 psi; stainless steel and other alloys; standard sizes ⅝" through 6" I.D.; larger sizes also available.

THE PROBLEMS of pipe motion control are reduced to a minimum when you use CMH corrugated type expansion joints. Scientifically formed by advanced methods, they represent the modern, cost-saving, trouble-saving way to control axial, lateral or radial motion in piping or to correct for misalignment.

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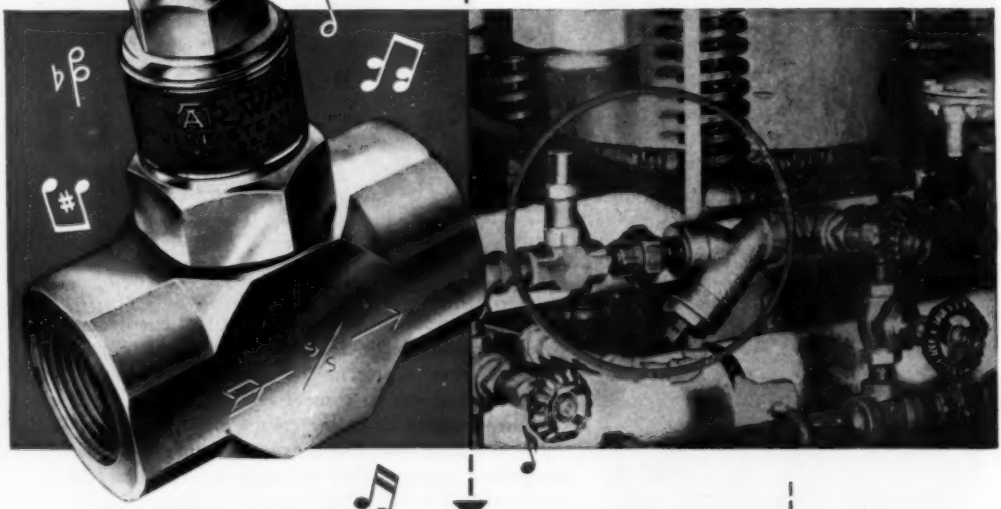
hot presses make sweet music

If a 30% increase in production sounds like sweet music to you—keep your ear tuned to this story.

One of the largest manufacturers of phonograph records recently relocated 60 of their record presses, and also equipped each one with a ½" Yarway Impulse Steam Trap and Strainer. What happened? A 30% increase in record production . . . plus a decision to equip all 130 presses in the plant with Yarways.

It's another example of how these Yarway Impulse Traps can help increase production by sending the most premium B.T.U.'s at top temperatures into your product or process. In plant after plant, *they get equipment hotter, sooner and keep it hot.*



Other Yarway features—small size, easy hook-up, one moving part, low upkeep, stainless steel construction and low cost. Nearly 750,000 Yarway Impulse Steam Traps have already been installed.

It's always convenient to buy Yarway Traps and Strainers. One of the 216 industrial distributors who stock and sell them is located near you.

For his name, and a free copy of the new, helpful 24-page Yarway Steam Trap Catalog write—

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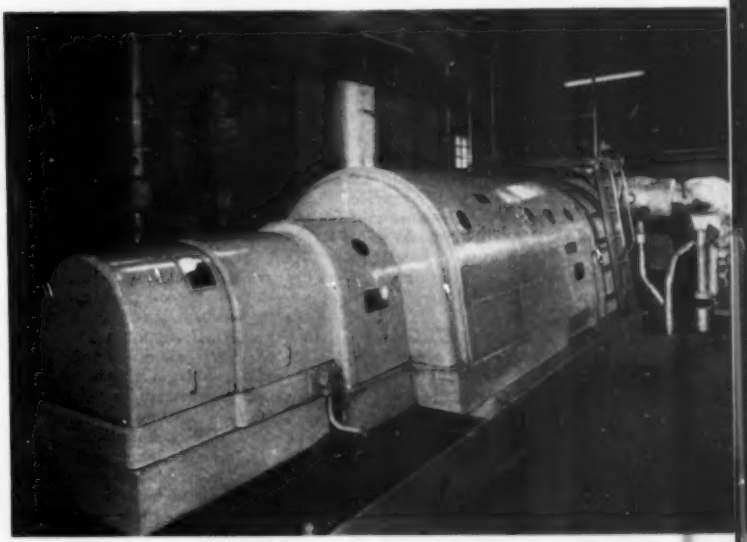
the steam trap designed with more production in mind

YARNALL-WARING COMPANY 109 MERMAID AVE., PHILADELPHIA 18, PA.

INDUSTRIAL POWER

October, 1951 Vol. 61, No. 4



This modern turbine generator set and the motors it drives produced savings that almost make operation of refining equipment a by-product of the process steam generated. Remote speed changing and synchronizing controls simplify operation

GENERATOR POWERED BY PROCESS STEAM BRINGS MOTORIZATION, LOW COSTS

W. J. MATHEWS, *Chief Engineer*
Refined Syrups & Sugars, Inc.

By installing a new turbine generator unit and replacing steam drives with electric motors, steam required for the sugar refining operations was reduced 22 per cent, leading to plans for more than doubling present generating capacity. Adequate controls and modernized coal pulverizers help in the ease of operation and maintenance and increase savings

ECONOMICAL manufacture of liquid sugar at the required low sales margins depends on a round-the-clock flow of process steam and electrical power at the lowest possible cost. When existing steam turbine generator capacity at Refined Syrups & Sugars, Incorporated, Yonkers, N. Y., became inadequate to deliver the required amount of electrical power at economical rates, a new 2000 kw steam turbine generator was installed.

This new unit is rated at 2000 kw, 80 per cent power factor, 480 v, 3 phase, 60 c and now operates at peak loads of 1850 kw. It is a straight impulse type machine, has 13 stages, operates at 3600 rpm and employs four bearing construction, two for the turbine and two for the generator with an oil lubricated flexible coupling between. Previous generating equipment, which consisted of two steam turbine generator units rated at 1000 kw and 650 kw, delivered no more than 1400 kw because of excessive internal wear and bearing difficulties. These old units are now rated as standby emergency equipment for the plant.

The speed governor of the new unit is an oil relay type and permits speed control by hand at the unit, or remotely by use of a small motor.

The generator has a sealed air cooling system. Fans on the rotor circulate the air within the system through a shell and tube type heat exchanger using nearby Hudson River water as the cooling medium. This keeps the generator windings clean and free of contaminated air. Copper-nickel tubes of the heat exchanger successfully resist the highly corrosive action of river water and eliminate the necessity of special water treatment.

Lubricating oil is supplied to the turbine generator unit from a 150 gal reservoir through a forced feed system. This oil receives continuous clarification by centrifuge and is constantly circulated through a shell and tube type heat exchanger employing softened makeup water as the cooling medium. Since it is desirable to maintain a fairly even oil temperature, and that of makeup water varies due to seasonal changes, an automatic temperature device is used to control flow of water to the oil cooler.

Electrical control of the generator is the steel enclosed switchgear type. In

addition to normal instrumentation and overload and low-voltage protective devices, differential relays protect the generator against any unusual unbalanced load condition. A push button switch is also provided for control of the small motor on the governor so that speed changing for synchronizing with the other units can be accomplished by the operator, if desired, at the switchgear.

Since installation, the new generating equipment has operated 24 hours a day, 7 days a week, generating approximately 40,000 kwh daily. Steam enters the turbine through a 10 in. inlet pipe at 250 psig pressure with 50 F superheat and exhausts to the process steam system of the sugar refinery at 15 psig through a 20 in pipe.

Nearly 2,900,000 lb of process steam a day are required to serve such refining plant equipment as vacuum pans, evaporators, heat exchangers (for water and liquid sugars), clarifiers, blow-off tanks and mixers. About 75 per cent of the process steam is returned to the makeup water supply as condensate, the balance being consumed by direct injection into sugar liquors, lost by contamination or by being too far from the boilers for economic return.

It is interesting to note that the company, by changing much of its steam driven refinery equipment to electrical motor drive, has achieved a 22 per cent reduction in amount of steam required to produce 100 lb of liquid sugar, and obtained a corresponding reduction in coal consumption in the boiler plant.

The new generating unit has a steam rate performance of 28.3 lb per kwh and the boiler plant generates approximately 11 lb of steam per lb of coal. Based on these figures and the 40,000 kwh generated daily, about 1,100,000 lb of steam passes through the turbine of the unit. 50 ton of coal per day is required to produce this flow of steam. This means that the electrical energy used in the refinery becomes a by-product of the steam used since, as already stated, nearly 2,900,000 lb of process steam per day, with a corresponding coal consumption of 130 ton is required.

This differential between amount of steam passing through the turbine generator for the required electrical load and the total amount used in the refinery makes it possible to carry out the program of more motorization of steam driven refinery apparatus. This will further reduce consumption of steam and coal for production of sugar. Current study of plant requirements indicates that an additional turbine generator of 2500 or 3000 kw capacity would most economically reduce the differential, increase motorization and provide desirable cost reductions in production of steam and electrical power.

Current fuel supply is bituminous, ⅜ in. slack coal, delivered in 1000 ton lots by railroad and barge. As a precautionary measure a reserve pile of 5000 ton is maintained in an adjacent field area. The coal undergoes a primary crushing, is weighed and transferred by a weigh-belt to 500 ton catenary overhead bunkers after passing over a magnetized pulley for tramp iron separation.

Two 60,000 lb per hr generators provide the required steam, automatically controlled so as to balance output against demand with the maximum flow automatically limited to the capacity of the steam generators. The turbine generator was designed to suit the steam condition and to carry the kw load needed to meet plant power requirements.

Steam generators are the ring, unidirectional type, and employ a washer and separator that assures a sufficient flow of clean, dry steam through superheater and three non-return valves to a common header. Four unit pulverizers feed the required mixture of hot air and coal to the two boilers. Primary air, fed to the pulverizer by an integrally driven fan, heats the coal to 250 F. The coal drops over a magnetized vibrator feeder-mixer to a first stage crusher for impact breakdown (with a scrubbing action) and then to an attrition stage where it is in constant suspension. Pulverized coal is blown by the pulverizer fan direct to the burners and mixed with secondary air.

Pulverizers are set on vibration eliminators. They have been modernized by facing the grinding parts with tungsten carbide. In addition to increasing life of the parts, down time has been eliminated and a sustained state of finer pulverization has been achieved. Flyash is also reduced.

When steam flow goes over 65,000 lb per hr, a valve on the combustion control board automatically reduces amount of steam going to the refining plant. The master sender controls coal supply to both boilers and controls air supply in the induced and forced draft system.

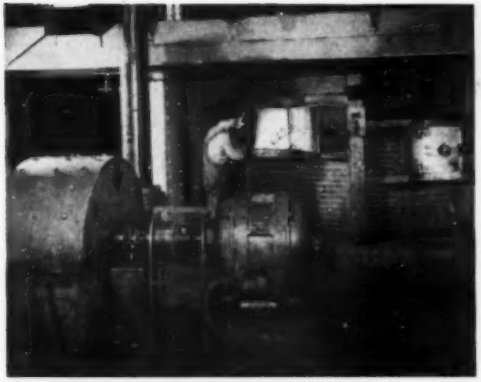
City water is supplied through a zeolite softening system to storage tanks for makeup boiler supply at the rate of 10,000 cu ft a day. Additional chemical treatment is automatically provided to boiler water supply by two pumps, actuated by a makeup meter controlled device.

Hudson River water is supplied for refinery purposes by either or both of two 4000 gpm pumps.

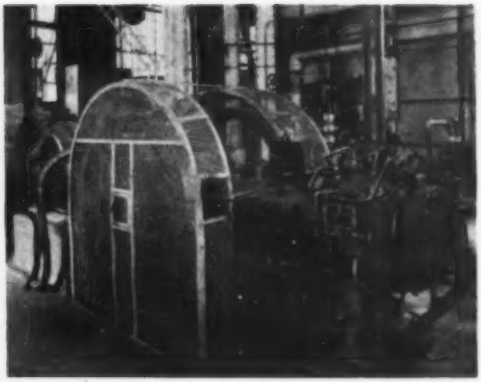
Distribution of the end product, refined liquid sugar, to bakers, brewers, confectioners and other trade markets is made by a fleet of stainless steel tank trucks, and by railroad, barge and boat from the company pier.

PRINCIPAL EQUIPMENT AT REFINED SYRUPS & SUGARS, INC.

Steam generators	Riley Stoker Corp.
Coal pulverizers	Riley Stoker Corp.
Boiler feed pumps	Worthington Pump & Machinery Co.
Feedwater heater	Hoppes Manufacturing Co.
Feedwater regulators	The Swartwout Co.
ID and FD fans	B. F. Sturtevant Co.
Combustion control board	Hagan Corp.
Water softeners	Elgin Softener Corp.
Chemical feed pumps	Worthington Pump & Machinery Corp.
Continuous blowdown flash tank	Elgin Softener Corp.
Air compressor	Chicago Pneumatic Tool Co.
Smoke indicator recorder and alarm	General Electric Co.
625 kw turbine generator	Westinghouse Electric Corp.
1000 kw turbine generator	General Electric Co.
2000 kw turbine generator	Worthington Pump & Machinery Corp.
Voltage regulator, 625 kw unit	General Electric Co.
Voltage regulator, 1000 kw unit	General Electric Co.
Voltage regulator, 2000 kw unit	Allis-Chalmers Mfg. Co.
Main breaker, 625 kw unit	Allis-Chalmers Mfg. Co.
Main breaker, 1000 kw unit	Allis-Chalmers Mfg. Co.
Main breaker, 2000 kw unit	Roller-Smith Co.
Injection water pumps	Lecourtenay Co.
Windial (speed and direction)	Bendix Aviation Corp.
Coal Scale	Merrick Scale Co.
Air cooler, 2000 kw generator	Schutte & Koerting Co.
Lubricating oil	Socony Vacuum Oil Co.
Oil purifier 200 kw	The DeLaval Separator Co.
Oil purifier 625 and 1000 kw units	Bowser Inc.
Fuel oil pumps	Viking Pump Co.
Conveyer belts	Robinson-Brannin Co.
Vibration eliminator (pulverizers)	The Vibration Eliminator Co.
Magnetic pulley (coal conveyer)	Kiekhaefer Corp.
Synchronizing equipment	U. S. Electrical Motors, Inc.

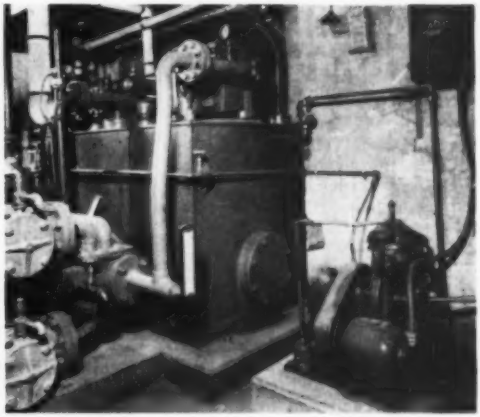


Two 60,000 lb per hr steam generators operate continuously to produce nearly 3 million lb per day for refining sugars

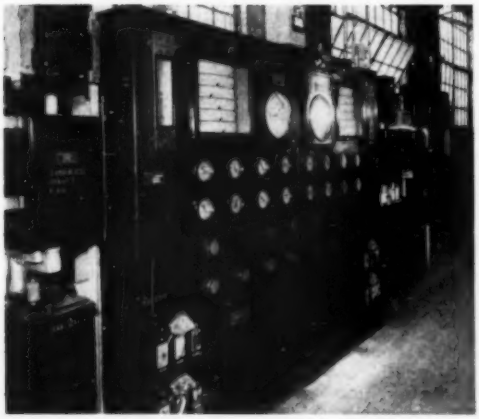


Air compressors used in conjunction with the boilers which supply steam for process and electrical power generation

Coal pulverizers were modernized by hard facing grinding parts, increasing life and reducing maintenance and flyash

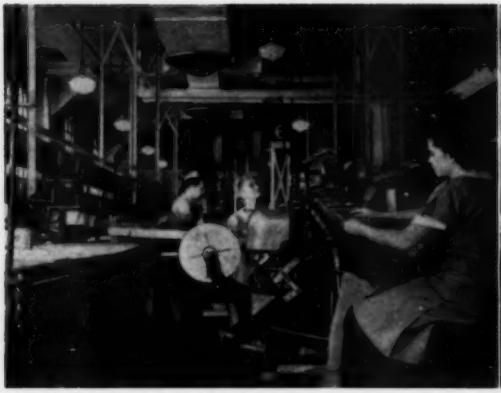


This oil separator is part of the force feed lubrication. The oil is continuously clarified, has controlled cooling



Combustion control board supervises boiler conditions for efficient operation in supplying steam for process and power

Control panel for the turbine generator has synchronizing panel handy at right for synchronization at the switchgear



Air distribution and humidity control play an important role in the proper manufacture of candy at this factory

Temperature and relative humidity are maintained in all areas in this wire plant to assure exact final dimensions

INDUSTRIAL AIR CONDITIONING . . . . ITS

Here are some of the modern applications of that useful tool, air conditioning, as they are applied to industry for processing, protecting highly polished metals, humidity control and employee health

F. HONERKAMP, *Chief Engineer, Anemostat Corp. of America*

AIR CONDITIONING helps industry to produce better products. It prevents waste, preserves and improves health, safety and efficiency of the workers. It is indispensable for many manufacturing processes, is of great value to industrial plants generally and will play an important role in any future emergency.

In industry, air conditioning is frequently concerned with control of atmospheric conditions needed for manufacture, processing and preservation of material and equipment. In other cases, it may serve only to provide a favorable industrial environment for workers. In many installations adjusting air conditions is possible so as to provide a reasonable compromise between the requirements of the process and the health and comfort of the workers.

Here are some of the ways air conditioning is used in the process and storage of materials: 1. control of moisture content, 2. control of the rate of chemical reactions, 3. control of the rate of biochemical reactions, 4. control of the rate of crystallization, 5. close tolerance machining and grinding (control of temperature), 6. protection of highly polished surfaces (control of dew-point), 7. elimination of static electricity (control of humidity), and 8. control of conditions for material testing laboratories.

Industrial air conditioning is concerned with the definite control of the atmospheric industrial environment, and it is, therefore, closely related to proper heating and ventilating. Air conditioning and heating of large factory spaces usually are handled by one system. Heat may be distributed by radiators, steam unit heaters, direct-fired unit heaters or central warm-air installations with duct work.

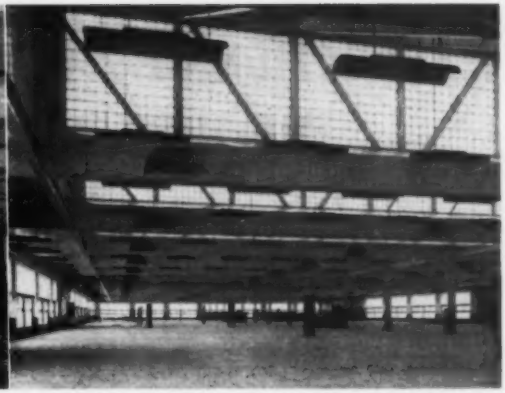
Propeller-type unit heaters with downward discharge have been utilized to advantage in buildings with low and medium high ceilings, but they do not always provide satisfactory air distribution. High outlet velocities have to be employed in order to direct the air stream downward with sufficient force — and this might cause discomfort to the workmen beneath the heaters. Furthermore, the area covered is restricted. The great advantage in the use of propeller fan unit heaters is that no duct work is required. Centrifugal fan unit heaters frequently require installation of ducts with special air outlets in order to improve the air distribution.

In factories, especially assembly plants, where steam is not available or economical, direct-fired heaters for coal, gas or oil can be successfully applied. Such units occupy only small floor areas, are capable of firing efficiently and are dependable and safe. They are used either as unit heaters or simplified decentralized heating systems with duct work. However, unit heaters are not too practical in plants where processes create quantities of heat and smoke — in such cases, fresh air is needed to maintain proper air conditions for workers, and a duct system provides the solution.

Proper distribution of air in large buildings is often a difficult problem, especially in plants with large window areas, where heat losses from glass result in a relatively high temperature differential between supply air and the air in the enclosure. Ceiling outlets of large capacities are the only means of handling the necessary large air quantities. Buildings with high ceilings have worked out well using unit heaters combined with aspirating air diffusers. These units are of simple design, are inexpensive and dependable and give satisfactory air distribution even under difficult conditions.

Importance of proper air conditioning and air distribution cannot be stressed enough. When compared to an ideally designed ventilating system,

Sensitized paper storage room is maintained at a constant relative humidity to preserve properties of chemical paper



Draft free distribution of air can be obtained with duct work and efficient outlet grills, even under saw-tooth roof

APPLICATION WITH GOOD AIR DISTRIBUTION

the air conditioning installation is often justified on the basis of saving in first cost alone. Air diffusers are now available that permit introduction of conditioned air into spaces at considerably lower temperatures — yet without objectionable drafts. This makes possible the caring for a given heat load in a space with lower volumes of air than ever before.

Perhaps the best way to illustrate what can be done with air conditioning in a large industrial plant is to select a typical case and describe the problem and its solution. A windowless factory that measures 720 x 1780 ft is divided into ten equal smaller sections each 160 ft wide plus three service bays. The center service bay is 80 ft wide and the two others are 50 ft wide. Height from floor to the bottom of the chord of the roof trusses is 40 ft. The service bays are lower than the main sections and have machine shops on the first floor and offices on the second.

Heating is with 18 direct-fired unit heaters, each having a capacity of 6,000,000 Btu. They are fed by a bin-feed coal stoker and equipped with a 75,000 cfm fan, driven by a 60 hp motor. Heaters and their accessories are placed in batteries of three in the basements of the service bays near the side walls of the buildings. This arrangement permits a simple duct layout.

Each of the six heater rooms has two air shafts of approximately 10 x 17 ft that extend above the roof to small penthouses equipped with louvers. The percentage of fresh air taken in by the heater room fans can be varied to any desired amount, and air can be entirely recirculated. Heaters and fans are in the same plenum chamber, which is separated from the firing room, in order that dust and coal cannot mix with the hot air.

Duct work in the plant is non-metallic — asbestos cement board, 3/16 and 1/4 in. thick, was fabricated on the job. Heating of the main ten sections is independent of the offices and the machine shops in the service bays. Ducts for the main sections run through the trusses or steel superstructure, 48 ft above the floor. The specifications required that no heating should occupy any of the space in the main sections below the roof trusses, 40 ft above the floor.

A total of 160 aspirating air diffusers was installed in the main section of the plant, and they were mounted at the bottom chord of the roof trusses. In order to avoid stratification and to uniformly distribute air over the whole area the neck velocity is over 2000 fpm. Neck diameters of the air diffusers range from about 20 to 30 in., and units supply air quantities from 5000 to 10,000 cfm. In spite of the unusual height of the outlets the air is evenly distributed.

In the offices on the second floor of the service bays, the air is distributed by aspirating diffusers of a different type. In addition to the outlets used for distribution of the heated air in winter, additional outlets for ventilating purposes in summer were necessary in order to handle the increased air volume (ten changes per hour). Heater fans are used to help carry this summer ventilating load, which is large where this factory was constructed.

In the offices, for example, about 75,000 cfm of air are handled during the winter and 190,000 cfm of air during the summer. Of this amount about 84,000 cfm are distributed by the additional ventilation outlets and 106,000 cfm by the heating outlets, which in summer also handle ventilation air. Nearly 300 aspirating diffusers are installed in the office space.

This installation had some unusual problems for the air conditioning engineer to solve and one was the extreme ceiling height. The remarkable success of the installation was in no small degree due to use of scientifically designed air diffusers. Because of their unique ability to draw in up to 35 per cent of room air and mix it with incoming supply air before discharge in the form of air blankets of low velocity, the system is able to provide draftless conditions at the worker level, both in summer and winter.

Air conditioning should be an organic part of the industrial building. Therefore, cooperation between architect and mechanical engineer is of utmost importance for the proper integration into the structure. In selecting an air conditioning system performance, first cost and maintenance expense must be considered, as well as the amount of space needed and equipment weight. Ease of installation and access for servicing are also important items to consider.

SELECTION OF A-C MOTOR CONTROLLERS FOR HIGH VOLTAGE SYSTEMS

Motor controllers for 2300 and 4600 v systems come in standard and high interrupting capacity ratings, and in various types designed for many applications. Here are ratings, construction details, comparative costs and other information that will help in selecting the best equipment for the job and the location

T. F. BELLINGER, *Engineer, Allis-Chalmers Mfg. Co.*

BALANCE between use of low and high voltage a-c electrical equipment has recently swung heavily towards the latter. This trend is quite marked in new large plants and such major expansion projects as cement, chemical, mining, paper, petroleum, rubber, steel industries and public utilities.

Low a-c voltages are those of 600 v and less, while those above are termed high voltages. However, next standard value above 600 is 2300 v and the general conception of high voltages are those of 2000 v and up. Ratings between 600 and 2000 v will not be covered here because they are not standard in the United States.

Advantages of High Voltages

Major advantages of high voltage power systems are improved system stability, lower overall costs, and greater available load capacities. They allow much smaller values of load current on feeder lines, reducing line losses and voltage variations caused by switching heavy system loads. This is especially important where large motors, started on a heavily loaded system, cause a drop in voltage and unwanted shut down of other motors. On low voltage systems, more costly type of control equipment is required to reduce motor current surges during starting.

An appreciable saving in both initial costs and plant space is possible if the plant system voltage is identical to that of the power line entering the plant, eliminating step down transformers for feeder supply.

For motors and controllers up to approximately 150 hp, low voltage equipment is the cheaper. Above this point, high voltage costs become less. For example, a 220 v controller will cost, on an average, about 50 per cent as much as a 2300 v unit below 125 hp, will be approximately equal at 125 hp, and 40 per cent more at 250 hp. A 2300 v motor will cost approximately 5 per cent less than a 220 v motor for ratings above 200 hp. Controllers for motors above 250 hp at 220 v or 500 hp at 440 v are not readily available and must be considered as special equipment.

Economics of low and high voltage systems will be governed by size of the system and power class of the majority of the motors. Circuits connected only to fractional and small horsepower polyphase motors should without doubt be below 600 v.

Practicability and cost of acquiring and protecting several hundreds of thousands of available kva capacity is the major advantage of high voltage systems. Available reserve power is essential for future plant expansions and for voltage stability of the system.

High voltages in the past had been considered a menace to safety of plant personnel, but because of enforced safety codes, better insulation, improved controller designs and a more highly trained plant operating personnel, the belief has been greatly reduced. Completely enclosed motor controllers and bus runs have been a big factor in preventing electrical accidents.

Standard High Voltage Units

Standard controllers for use with high voltage a-c polyphase motors have maximum ratings of 5000 v and are available for motors up to and including 3000 hp, 100 per cent pf at 4600 v. Table 1 gives maximum ratings of a-c industrial motor controllers. At higher voltages, a much more costly type of equipment is required.

Controllers start and stop motors. They can provide across-the-line full voltage, reduced voltage, or part winding starting on any voltage up to their maximum rating. Units for full voltage starting are least expensive and require only one high voltage switch, while other types require two or more. Reduced voltage and part winding starting are employed to minimize the starting shock to the electrical system and to the driven equipment.

A high voltage controller includes framework or enclosure, line switch, overcurrent relays, and auxiliary devices. They have been available in either the open framework or completely enclosed models. Demand for open units is small because of safety hazards and appearance and they are to be discontinued by most manufacturers.

Enclosures consist of a self supporting steel structure with the bottom usually open for power connections.

TABLE 1—MAXIMUM HORSEPOWER RATINGS OF HIGH VOLTAGE A-C CONTROLLERS

Rating, amp	2200 - 2300 v		4000 - 4600 v	
	100% pf	80% pf	100% pf	80% pf
100	450	350		
200	900	700	1500	1250
400	1750	1500	3000	2500

Fig. 1—Modern high voltage motor controllers are metal enclosed and often combined in groups. Current limiting fuses and mounts function as interrupters and disconnect switches

Fig. 2 (right)—Controller enclosures contain control and instrument transformers, relays and components necessary for operation. Modern means for servicing are convenient

The line switch is an electrically operated contactor of the oil immersed or the air break type. Both have standard current ratings of 100, 200 and 400 amp at a maximum of 5000 v a-c. They are required by NEMA Industrial Control Standards to interrupt 10 times full load current and carry 15 times full load current for one second. The air break type is the more recent development and fast gaining popularity because absence of an oil operating medium greatly lessens the chance of fires and reduces maintenance.

Overcurrent protection is provided by thermal type relays that usually operate from the secondaries of current transformers. Auxiliary equipment consists of control relays, control and current transformers, timing devices, field application equipment and other devices required for the particular circuit and motor with which they are used.

High Interrupting Capacity

Because of the large quantities of power available to plant high voltage feeder systems, provision for short-circuit protection becomes a major problem. Mechanical circuit interrupters capable of clearing fault currents of 50,000 to 60,000 amp on the high voltage system are extremely costly, require considerable space and maintenance, and usually protect a number of controller-motor units. The entire group will be shut down by a fault or maintenance work on any one motor or controller.

To meet the problem, a high voltage motor controller was developed to provide standard starting functions and yet have a short-circuit interrupting capacity of 150,000 kva at 2300 v and 250,000 kva at 5600 v. These units are completely self-contained and used individually or assembled to form a group lineup with a common enclosed high voltage primary bus. Approximately two units of this type could be purchased for the cost of one circuit interrupter providing the same protection. However, the controllers provide short-circuit protection for the motor only and will not protect the feeder lines.

Short-circuit protection is provided by primary high voltage current limiting fuses that serve a dual purpose as interrupters and hook-stick operated disconnect switches. The fuses, inserted on the line side of the high voltage contactor, are mounted on disconnect type holders in a separate compartment as in Fig. 1. Fig. 2 shows the rear view.

Fuse units are specifically designed for short circuit interruption service on individual motor circuits and are not applied for normal overload protection. Successful operation of the complete controller depends on exact coordination between fuses and thermal overload relays. At no time should fuses be applied on existing control installations without the recommendations of the fuse manufacturer.

On short circuits, the conducting elements of the fuses melt before the current in the first major half cycle loop can reach its peak value. Operation is shown in Fig. 4, taken from an actual test oscillogram. Assume that a fault on the system occurs at point 0 on the voltage wave and causes a current I, which lags the voltage by approximately 90 deg. The dotted curve for I indicates the first cycle of current for sustained fault conditions.

The solid curve I^2 shows the actual current flow permitted by the limiting characteristic and high interrupting speed of the fuse. The shaded area under the curve covers melting time; the dotted area indicates arcing time until interruption is complete at B. Fig. 5 gives typical characteristics for two sizes of fuses.

Although general purpose controllers are suitable for about 90 per cent of all applications, some conditions necessitate modified and specially constructed enclosures and auxiliary device arrangements.

For Hazardous Locations

A controller has been developed for the petroleum, chemical and coal handling industries and is suitable for op-

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eration in hazardous locations of explosive atmospheres but does not have Underwriters' approval because standards for such equipment are not available at present.

The unit is an assembly of a high voltage oil immersed contactor, overload relays and control transformer, suspended in a tightly sealed tank in switch oil that completely covers all components. Threaded conduit openings and seal glands provide gas and moisture-tight entrances. This type is also suited for extremely dusty locations and for outdoor installation.

The high voltage controller for hazardous locations is available only for full voltage starting of motors. Maximum rating is 5000 v.

For Semihazardous Locations

In the last decade, the petroleum industry has turned to electric motor drives. Electrical installations made are mostly of high voltage design. Many controllers are required in hazardous locations such as refineries and pumping stations. Considerable cost and inconvenience was necessary to apply standard controllers in such surroundings and a high interrupting capacity, high voltage unit was produced for the service. It is classed as being suitable for "semihazardous" locations where inflammable vapors or gases are present in sufficient quantities to produce explosions. This type has been successfully employed for both full and reduced voltage starting of motors by the petroleum industry and is suitable for many other industries where safety codes and regulations permit.

The controller for semihazardous locations consists of identical components used in the general purpose unit but with additional features. Fuses are completely sealed and will not produce exposed flames or gases on fuse interruptions. The line contactor is oil immersed, having all arcing parts submerged. All low voltage devices capable of producing electrical arcs (such as relays, contactors, fuses and resistors) are in cast iron explosion-proof cases mounted within the enclosure and with compound filled entrance bushings and fireproof plastic insulated wires and cables. Thermal type overload relays have automatic resets.

If a control or potential transformer is used on the controller, primaries may be connected on the line side of the fuses to eliminate arcing from magnetizing currents when disconnects are opened. Windings remain energized continuously except by clearing the feeder line. An explosion-proof limit switch on the fuse compartment door automatically shuts down the motor when the door is opened, preventing the disconnects being pulled while carrying the motor current.

High voltage controllers for semihazardous locations protect against explosions produced by abnormal conditions such as insulation failures, faulty or loose connections and static discharges. They cost approximately 25 per cent more than comparable ratings of standard general purpose controllers.

For Dusty Locations

NEMA type 1A, semihazardous enclosures consist of the general purpose enclosure with dust seals added in visible openings and around the swinging doors and panels. Material used is usually a soft felt or rubber compressed between adjacent surfaces. The enclosures are effective in preventing the rapid build up of dust and other foreign matter that could cause faulty controller operation but will not exclude all such materials.

Controllers with semidust-tight enclosures usually cost about $100 more than with a general purpose enclosure. They are widely used in the cement, fertilizer, textile and other industries.

For Outdoor Locations

Enclosures for installation out-of-doors are classed as NEMA type 3, weather-proof, and are the general purpose type with gasketed covers and doors and necessary drip and drain shields. They are by no means watertight but merely prevent the elements from hindering the operation of the controllers and have been applied in mines, pump houses, boiler rooms and other places where falling, splashing or spraying of water is found. A controller with weather-proof enclosure adds approximately $150 to the cost of the general purpose type.

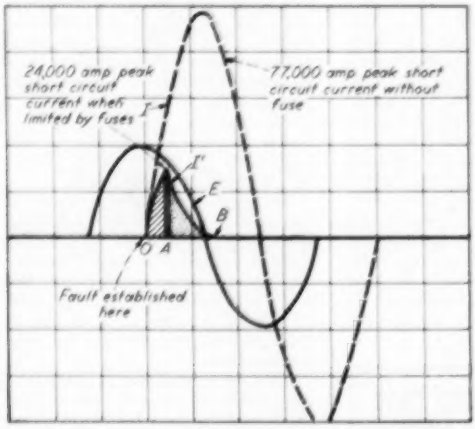


Fig. 3—In test circuit, fault current would have followed curve 1 without fuse. Current limiting fuse held it to I'. Melting time of link is shaded, arcing time is dotted

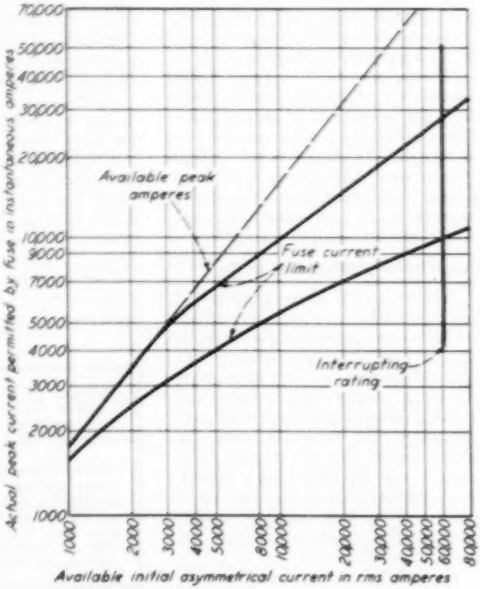
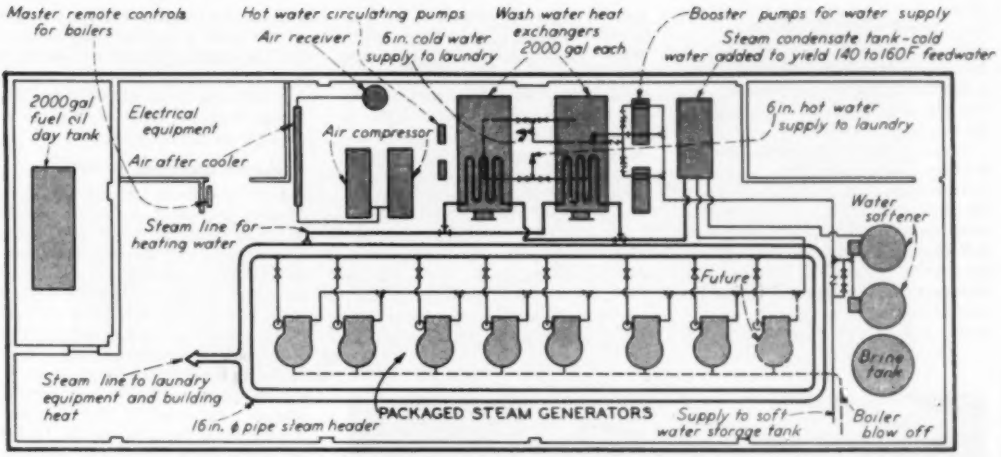


Fig. 4 (right)—On current limiting fuse characteristics for 2300 v, 600 per cent starting inrush, 75 and 300 hp motors, dotted line indicates maximum peak without fuses


Master remote controls for boilers
Hot water circulating pumps
Air receiver
6 in. cold water supply to laundry
Wash water heat exchangers 2000 gal each
Booster pumps for water supply
Steam condensate tank-cold water added to yield 140 to 160F feedwater
2000 gal fuel oil day tank
Electrical equipment
Air after cooler
Air compressor
6 in. hot water supply to laundry
Water softener
Steam line for heating water
Future
Brine tank
Steam line to laundry equipment and building heat
16 in. ϕ pipe steam header
PACKAGED STEAM GENERATORS
Supply to soft water storage tank
Boiler blow off

Arrangement of steam generators and auxiliaries that supply 13,000 gal of hot water per hr for laundry

PACKAGED BOILERS IN SERIES SERVE RAILROAD'S CENTRAL LAUNDRY

Seven units with total capacity of 31,500 lb per hr supply steam at 100 psi for processing operations and building heat; handle laundry for all U.P.'s passenger trains, hotels and restaurants

L. W. ASHTON, *Engineer, Union Pacific Railway Company*

HOT WATER and steam heat for the Union Pacific railroad's new central laundry at Ogden, Utah, is supplied by a battery of seven Vapor-Clarkson fully automatic packaged steam generators. Approximately 3300 lb of dry laundry every hour is being processed. This means that 13,333 pieces of dirty laundry will be unloaded at the south end of the newly erected building and within 1.5 hr will come out the other end of the building, washed, dried, ironed, folded, counted and tied in bundles ready for delivery to commissary across the street.

Each of the seven steam generators installed in the U. P. laundry is rated at 4500 lb of steam per hr. Total steam production is 31,500 lb per hr. The speed with which they can be put into operation is illustrated by the fact that each boiler can develope 250 psi in 2 min from cold water. However, the boilers are operated at 100 psi, the pressure required for laundry processing. The steam generators operate at efficiency between 80 and 82 per cent between one-third and full-rated capacity.

The generators are each fired with fuel oil and are completely automatic in operation from one-third to full capacity. A specially designed steam pressure switch starts the fire in one or more units when steam pressure in the line is down, and shuts down when the line pressure is high.

A unified control panel for the seven boilers is located in one corner of the plant. Electric circuits incorporating low-water and steam-pressure limit switches are interlocked through a program relay to control automatic ignition, flame-failure safety device, fuel-burner sequence, motor and oil-heater starters, and dampers that regulate the fuel-air ration. Open limit switches as well as power failure cause instantaneous burner shutdown.

When the 100 lb working pressure is reached, the fire is automatically shut off, but feedwater pump continues to operate the water pump, and when this happens the water automatically by-passes the boiler coils and returns to the water supply. An excessive water-pressure reading on the gage indicates that the coils are in need of cleaning, which is done by making two exterior connection and circulating an inhibited 20 per cent solution of muriatic acid.

Since no large quantity of water is heated under pressure, there is no possibility of the unit blowing up. However, as mentioned above, many safety devices are used to insure safe operation. The feedwater is treated by the "stick" method in a small tank mounted on the base plate of the steam generator.

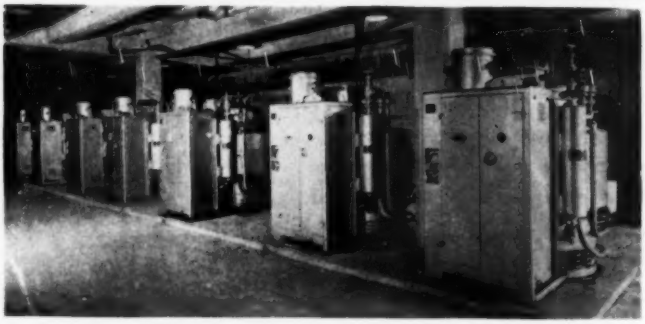
At the Ogden U. P. laundry, the machines are used, not only to heat the water to 180 deg for laundering operations, but to heat the building in winter. Steam developed by the generators is used to operate washers, ironers and pressers. In the basement of the building there are two large heat exchanger tanks, each of 2000 gal capacity. The steam not used in pressers is condensed and re-generated.

About 13,000 gal of water will be used every hour.

Because of the heat generated in laundering operations, the laundry has a ventilating and air-conditioning system which changes the air throughout the building every 90 sec.

Installed at the laundry are eight washers, three extractors, four flatwork ironers, three dryers, 12 tumblers, 42 press units, six folders, one stacker, three tying machines, two continuous belt conveyers and a monorail system for moving baskets. The new plant will take care of linen from all Union Pacific passenger trains, Sun Valley and hotels and restaurants of the system with the exception of the southern Utah parks property of the railroad. A complete dry-cleaning system in the plant will handle drapes and uniforms for the entire railroad.

Engineering for the laundry was done by Union Pacific and Vapor engineers under the supervision of W. C. Perkins, Chief Engineer of the Union Pacific Railroad. L. W. Ashton is U. P. R. Engineer on location. Vapor engineers were N. O. Kirkby and J. E. LaRocque. Construction was done by Larson Construction and Engineering Company, Ogden, Utah.



Arrangement of the seven 4500 lb per hr packaged steam generators. Units can be cut in separately to handle varying steam loads at the laundry

Another Railroad Application*

Another interesting application of the Vapor-Clarkson steam generator is found on the New York Central System. This company installed for the first time a packaged boiler on a railroad pile driver. It produces 3,500 lb of steam per hr at pressures between 75 and 300 psi which is more than sufficient to supply the entire needs of the pile driving outfit even if it were engaged in placing piles by steam jetting. These needs include steam for driving two 12 in. by 16 in. steam engines used in propelling the outfit, for driving a compressor for operating the air brakes, for lifting and turning the pile driver leads, for activating a Vulcan No. 1 single-action steam hammer, for hoisting the piles into place in the leads, and for blowing the whistle.

Manned by a crew of 10 men, this pile driving outfit is comprised of a McMyler-Intrastate pile driver; a tender car with a steel underframe which carries a locomotive-type water tank and a fuel-oil tank; an idler flat car, also a steel underframe, for holding the pile driver lead and tools; and a small trailer push car carrying welding gas tanks and euipment. The total weight of this outfit is approximately 663,000 lb. The steam generator has moved it up a 2.25 per cent grade from a standing start and is capable of propelling it at a sustained speed of from 15 to 20 mph on a level grade.

Pressure Changed at Will

Since the steam generator is more compact and much lighter in weight than the cool-fired boiler it replaced, it was necessary to install counterweights in the cab of the pile driver for balancing the hammer and driving leads. Also in the cab is a 200 gal fuel oil tank which is refilled from the tank on the tender car after each day's work by the engineer of the rig by means of a hand pump, although daily replenishment is not essential. Water is taken directly from the tank on the tender car. Immediately behind the generator are two steam chests which are made to operate at 250 psi; the safety valves are set at this pressure. However, the steam generator is set to cut out at 200 psi and to go on again at 175 psi, and, unlike the former steam boiler, the steam pressure is maintained at 110 to 125 psi while the unit is moving from one location to another. Steam pressure can be changed by adjusting a dial.

A water pump, a fuel pump, a blower and a magneto on the steam generator are driven by a two-cylinder, air-cooled Wisconsin gas engine. The water pumper to the generator is continually turned into steam so that it is not necessary to shut down work operations while feedwater is being added to the packaged steam generator.

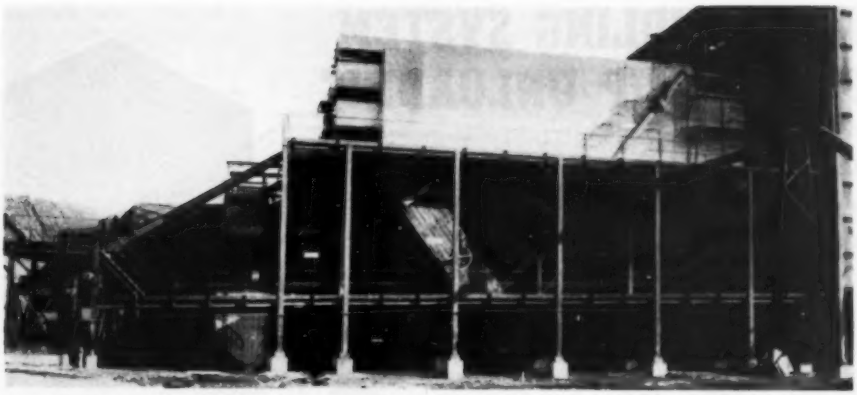
**Information for this application was obtained through the courtesy of the Vapor Heating Corp., builders of the Vapor-Clarkson packaged steam generator.*

New Type Glass Will Aid Electronics

• A new kind of glass which can be precision-machined through the use of ultraviolet light, heat and hydrofluoric acid to form intricately cut patterns of any desired shape and depth was described at the International Chemical Congress in New York City recently by S. D. Stookey, senior research associate of Corning Glass Works.

This new glass is the latest in a series of photosensitive compositions first announced by Corning in 1947 to produce permanent three-dimensional photographs in glass in a variety of colors. To the new composition, which is a special kind of photosensitive opal glass, Corning has adapted an equally new process of "chemical-machining," which produces without the aid of mechanical tools, lace-like patterns hitherto considered impossible in glass.

The versatility of the process has already been demonstrated in the manufacture of "printed" electrical circuits for electronic instruments. It appears certain that this new product will hasten important further advances in the field of electronics.



Over 66,500 sq ft of surface on coal processing units were insulated at 1050 F

INSULATING WHILE HOT PREVENTS EXPANSION TROUBLES

ENGINEERS at the Disco Corp., Imperial, Pa. have solved the problem of expansion cracks in thermal insulation by insulating high-temperature metal surfaces of their carbonizers and roasters at operating temperatures — up to 1050 F. Thermal expansion from shutdown to processing temperatures adds about 8 in. to the length of each carbonizer and 5 in. to the length of each roaster; insulation installed on the huge units while shut down would be very liable to crack and lose some of its effectiveness.

Installed at the plant are seven carbonizers each 125 ft long by 9 ft I. D., and seven roasters each of which measure 6x95x16 ft. These units process over 1000 tons of coal per day to produce Disco, a smokeless fuel from which liquors, tar and gases have been removed. The illustration above shows an insulated recirculating gas duct that leads diagonally from a roaster on top to a furnace below the carbonizer. To maintain the delicate process balances under all weather conditions, a total of 66,500 sq ft on seven such processing units were insulated.

The insulation was applied to all units in 24x48 in. blanket sections. On each of the seven roasters, 5000 sq ft of surface area was insulated with a single layer of a 4 in. thick blanket; average temperature of the metal surfaces was 750 F. Two 4 in. layers were applied to 450 sq ft of surface on each of the seven carbonizers at average temperatures of 975 F. The blankets, composed of mineral wool between metal lath and wire netting, were installed with the wire netting against the heated metal.

The insulating blankets were secured by 300,000 studs, welded to the metal on 9 in. centers. The studs were 5 in. long for the 4 in. thick insulation and 9 in. long for the 8 in. thickness. After all the blanket sections were impaled on the studs, galvanized iron bands were tightly wrapped on 12 in. centers around the carbonizers and roasters to ensure a long lasting insulation cover.

A lock washer was placed over each stud, 1 in. of which protruded above the metal lath permitting the stud ends to be bent over. A 1/2 in. thickness of insulating cement was applied in two 1/4 in. layers over the insulation. The first layer was trowelled into the metal lath and, after drying, the second layer was trowelled over it.

Then sections of 1 in. wire mesh were stretched over the cement and laced together with 18 gage galvanized iron wire. The mesh covering was secured by auto-clench staples driven into the cement on approximately 12 in. centers. As a weatherproof finish, asphalt mastic was trowelled into the mesh covering. The mastic was 1/8 in. thick when dry.

Insulating effectiveness is indicated by the temperature measurements in the table below. The temperatures on the outside insulation surface were measured at three points along a carbonizer and a roaster and compared with bare metal temperatures.

TEMPERATURE MEASUREMENTS ON BARE METAL AND OUTSIDE INSULATION

Point of temperature measurement	Thickness of insulation, in.*	Temperature of metal surface, F	Temperature on outside insulation surface, F**
Roaster:			
High end	4	900	140
Middle	4	750	123
Low end	4	680	119
Carbonizer:			
High end	8	1050	186
Middle	8	975	161
Low end	8	900	143

*Mineral wool blankets 24 in. wide and 48 in. long.

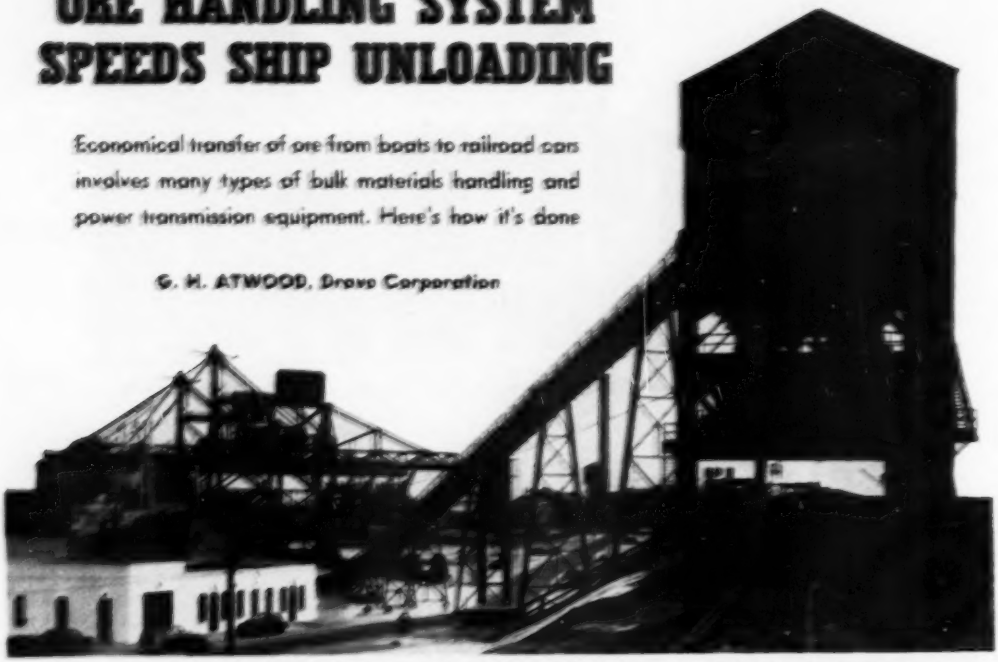
**Measured with mercury bulb thermometer completely insulated except for the tip, which was placed against insulation on the roaster and carbonizer.

NOTE: Information and data in this article were made available through the courtesy of Industrial Mineral Wool Institute, 441 Lexington Avenue, New York 17, N. Y.

ORE HANDLING SYSTEM SPEEDS SHIP UNLOADING

Economical transfer of ore from boats to railroad cars involves many types of bulk materials handling and power transmission equipment. Here's how it's done

G. H. ATWOOD, Dravo Corporation



Unloaders transfer ore from ships to belt conveyor, which carries it up to automatic weighing and car loading bin

FOR MANY YEARS engineers and ore operators have watched the increasing depletion rate of the higher grade iron ores of the Minnesota Mesabi range and have recognized the necessity for finding additional ore deposits elsewhere.

The extent to which new unloading facilities on the Eastern seaboard would be required depended upon how much ore would be imported. Officials and engineers of The Baltimore and Ohio Railroad Company had determined that increased unloading and car loading facilities would be needed and announced the decision early in 1950 to construct a huge import pier at Curtis Bay in the Port of Baltimore. The location is immediately adjacent to the railroad company's coal pier where the loading out of coal for water transportation makes available empty railroad cars which can be loaded with ore. Dravo Corporation was awarded the contracts for the ore unloading and ore handling facilities at the new pier, which was designed by Baltimore and Ohio engineers.

By its nature as a common carrier dock, the pier would be required to handle any materials offered from any type of vessel. Accordingly, volume capacities were based upon ore weighing 150 lb per cu ft but all mechanical, structural and electrical parts were designed to handle the same cubic measure of ores weighing 200 lb per cu ft. Gate and chute sizes, feeders and hoppers were designed for granular to 24 in. lump sizes. The problem of ship hatches was met with buckets of 200, 120 and 60 cu ft capacities.

Unloader Operation

Each unloader tower supports a horizontal runway for a man trolley and provides for an overall travel of 200 ft, made up of a front, or water side, cantilever with a working travel of 70 ft from the front legs of the tower, a fixed 65 ft runway through the tower, and a land side cantilever providing rear working travel of 65 ft for dock-side storage.

The front cantilever is in the form of a hinged apron which can be raised to clear ships rigging by means of a single drum, direct-connected electric hoist located in a machinery house at the top of the tower. The apron hoist drum is driven by a 65 hp motor.

The unloader man trolley has two 250 hp, force ventilated hoist motors and two trolley travel motors of 125 hp. Hoisting speed is 250 fpm and trolley travel balanced speed is 1000 fpm. Operating weight of the trolley is 112 tons with an average free digging cycle of 45 sec, transporting 150 lb ore at 1200 net ton per hr.

The bucket hoist consists of two parallel, 34 in. pitch diameter drums, one each for the closing and holding motors. In hoisting, both motors operate simultaneously. The trolley is spring mounted on four 33 in. diameter tapered tread, single flanged wheels. Each axle is driven by a single cradle mounted motor. On the trolley deck is a ring type turntable for rotating the smaller buckets. It consists of a cast turntable ring with vertical and horizontal rollers and a bevel rack for driving. A 6½ hp motor produces a turning speed of 9 rpm on the turntable ring. Wedge type rope sockets hold each bucket, which has its own separate set of ropes.

Bucket Equipment

The bucket for normal digging at high rate is a four-line type, reeved eight parts in the closing for power and moderate speed necessary for good performance when digging large and lumpy ores. The smaller buckets are the toggle link type, reeved in the bight of the line and utilizing six parts.

Operating weight of the entire tower

is 685 ton. Each corner is carried on eight 30 in., fully equalized, single flanged wheels, traveling on 171 lb track rails on 2 ft 6 in. centers. All eight wheels on each corner are driven by a 33 hp motor through worm gearing, universal joints and flexible couplings, with one worm set for each four wheels.

Four rail clamps for each tower hold it against a wind pressure of 40 psi. Clamps may be set in an emergency at the will of the operator, by power failure, or by operation of the anemometer which cuts off power at a predetermined wind velocity and applies brake and sets clamps. A 160 ton surge hopper delivers ore to the feeder under each unloader. Ore flow is regulated by a ratchet operated gate which, when set, determines the depth of ore on the feeder. The feeder itself is powered by a 15 hp variable speed motor and rate of feed to belt may be varied from 665 to 1330 ton per hour when handling 150 lb ore. Rubber impact idlers are mounted on feeder supports and carry the main conveyer belt at any loading point. A special arrangement of chutes, skirts and fingers permits finer material to reach the belt first so that larger lumps will fall onto a moving bed of finer material, giving longer belt life.

The main belt is 48 in. wide, travels at 400 fpm and handles 2000 ton of ore per hr. It is 9 x 11 ply with ¼ in. top cover with breaker strip and 1/16 in. bottom cover.

The conveyer has a total length of approximately 895 ft, travels horizontally along the dock beneath the two unloaders, rises along a vertical curve of 525 ft radius and ascends on a slope of 16 deg to the discharge bin.

A 200 hp motor powers the primary belt drive and a 100 hp motor the secondary drive. Drive pulleys are 72 in. diameter; tail pulley, 66 in.; snub pulleys, 36 in.; and take-up pulley, 48 in. Main drive pulley and secondary drive pulley are provided with vulcanized lagging and herringbone grooves. A vertical counterweighted take-up is employed, midway along the inclined portion. Primary drive for the conveyer is located in the drive room above the discharge bin.

The belt is the longest conveyer belt constructed and shipped in a single piece. The field splice is vulcanized.

Ore from the main conveyer is discharged into a 500 ton steel hopper below which are four heavy manganese steel apron feeders like those beneath the unloaders except that they are powered by 15 hp single speed motors. Each feeder transfers ore from the discharge bin to a spring mounted scale hopper having a maximum capacity of 40 ton of 150 lb ore. Scale hoppers, arranged in pairs over each loading track, are each equipped with motor operated double clam gates and discharge the ore to railroad cars approximately over the car trucks. Scales are of the straight lever type and can be preset to automatically weigh out any required tonnage of ore to properly load the car coming into position.

Electrical Power

Power for operation of the equipment is 230 v d-c. Main power supply to the site is 13,200 v a-c carried into a sub-station furnished by the railroad. Transformation and tube rectification produce the required d-c voltage.

Full magnetic control is used generally throughout the entire system and necessary safety interlocking and limit switch protection is provided.

The unloader is controlled from the operator's cab on the man trolley where master switches for trolley hoist and travel and for unloader tower travel as well as control of the unloader feeders are located. The trolley hoist has dynamic braking for lowering and limit switch protection on hoisting. Trolley travel is equipped with reversing plugging control with limit switch slow downs and final stops at either end of the trolley runway operative when speeds are excessive.

Other Controls

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Paddle type bin limit switches prevent the ore from overflowing the bin by stopping the unloader apron feeders while the hopper still can receive ore remaining on belt, or by stopping the main conveyer when the discharge bin is full.

The feeding of ore to the scale hoppers is started automatically by closing the gates at the bottom of the hopper. Loading continues until correct weight has been reached, after which the feeder is automatically stopped. Opening of gates to discharge the ore is performed by push button and the closing of the gates repeats the cycle.

Conveyer feeder mounted on unloader raises belt on rubber impact idlers and drops finer material first to cushion fall of lumps. Conveyer discharge is regulated by feeder

Two motor system operates conveyer, which uses the largest single-piece belt made. D-c power drives the 900 ft conveyer along the pier and up the 16 deg slope to the discharge bin

eration in hazardous locations of explosive atmospheres but does not have Underwriters' approval because standards for such equipment are not available at present.

The unit is an assembly of a high voltage oil immersed contactor, overload relays and control transformer, suspended in a tightly sealed tank in switch oil that completely covers all components. Threaded conduit openings and seal glands provide gas and moisture-tight entrances. This type is also suited for extremely dusty locations and for outdoor installation.

The high voltage controller for hazardous locations is available only for full voltage starting of motors. Maximum rating is 5000 v.

For Semihazardous Locations

In the last decade, the petroleum industry has turned to electric motor drives. Electrical installations made are mostly of high voltage design. Many controllers are required in hazardous locations such as refineries and pumping stations. Considerable cost and inconvenience was necessary to apply standard controllers in such surroundings and a high interrupting capacity, high voltage unit was produced for the service. It is classed as being suitable for "semihazardous" locations where inflammable vapors or gases are present in sufficient quantities to produce explosions. This type has been successfully employed for both full and reduced voltage starting of motors by the petroleum industry and is suitable for many other industries where safety codes and regulations permit.

The controller for semihazardous locations consists of identical components used in the general purpose unit but with additional features. Fuses are completely sealed and will not produce exposed flames or gases on fuse interruptions. The line contactor is oil immersed, having all arcing parts submerged. All low voltage devices capable of producing electrical arcs (such as relays, contactors, fuses and resistors) are in cast iron explosion-proof cases mounted within the enclosure and with compound filled entrance bushings and fireproof plastic insulated wires and cables. Thermal type overload relays have automatic resets.

If a control or potential transformer is used on the controller, primaries may be connected on the line side of the fuses to eliminate arcing from magnetizing currents when disconnects are opened. Windings remain energized continuously except by clearing the feeder line. An explosion-proof limit switch on the fuse compartment door automatically shuts down the motor when the door is opened, preventing the disconnects being pulled while carrying the motor current.

High voltage controllers for semihazardous locations protect against explosions produced by abnormal conditions such as insulation failures, faulty or loose connections and static discharges. They cost approximately 25 per cent more than comparable ratings of standard general purpose controllers.

For Dusty Locations

NEMA type 1A, semihazardous enclosures consist of the general purpose enclosure with dust seals added in visible openings and around the swinging doors and panels. Material used is usually a soft felt or rubber compressed between adjacent surfaces. The enclosures are effective in preventing the rapid build up of dust and other foreign matter that could cause faulty controller operation but will not exclude all such materials.

Controllers with semidust-tight enclosures usually cost about $100 more than with a general purpose enclosure. They are widely used in the cement, fertilizer, textile and other industries.

For Outdoor Locations

Enclosures for installation out-of-doors are classed as NEMA type 3, weather-proof, and are the general purpose type with gasketed covers and doors and necessary drip and drain shields. They are by no means watertight but merely prevent the elements from hindering the operation of the controllers and have been applied in mines, pump houses, boiler rooms and other places where falling, splashing or spraying of water is found. A controller with weather-proof enclosure adds approximately $150 to the cost of the general purpose type.

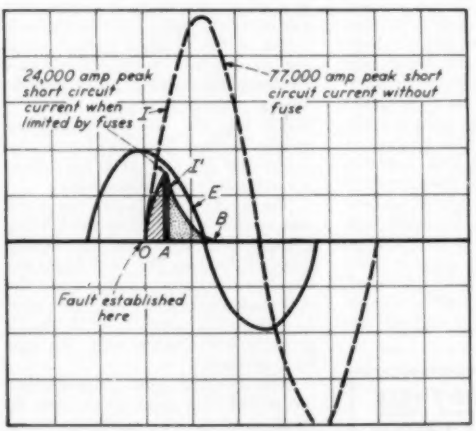


Fig. 3—In test circuit, fault current would have followed curve I without fuse. Current limiting fuse held it to I'. Melting time of link is shaded, arcing time is dotted

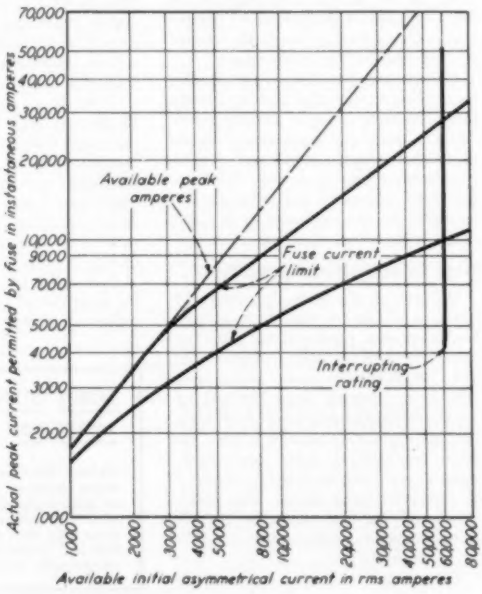
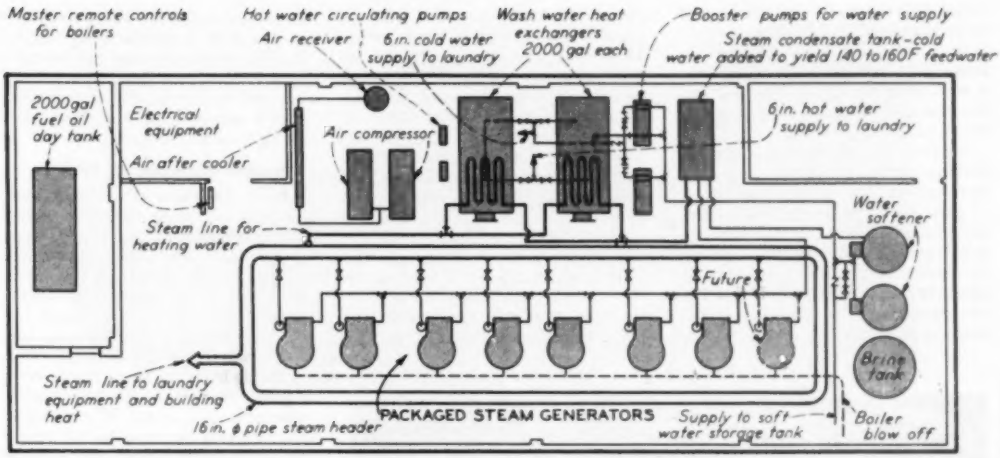


Fig. 4 (right)—On current limiting fuse characteristics for 2300 v, 600 per cent starting inrush, 75 and 300 hp motors, dotted line indicates maximum peak without fuses


Master remote controls for boilers
Hot water circulating pumps
Air receiver
6 in. cold water supply to laundry
Wash water heat exchangers 2000 gal each
Booster pumps for water supply
Steam condensate tank-cold water added to yield 140 to 160 F feedwater
2000 gal fuel oil day tank
Electrical equipment
Air after cooler
Air compressor
6 in. hot water supply to laundry
Water softener
Steam line for heating water
Future
Brine tank
Steam line to laundry equipment and building heat
16 in. ϕ pipe steam header
PACKAGED STEAM GENERATORS
Supply to soft water storage tank
Boiler blow off

Arrangement of steam generators and auxiliaries that supply 13,000 gal of hot water per hr for laundry

PACKAGED BOILERS IN SERIES SERVE RAILROAD'S CENTRAL LAUNDRY

Seven units with total capacity of 31,500 lb per hr supply steam at 100 psi for processing operations and building heat; handle laundry for all U.P.'s passenger trains, hotels and restaurants

L. W. ASHTON, *Engineer, Union Pacific Railway Company*

HOT WATER and steam heat for the Union Pacific railroad's new central laundry at Ogden, Utah, is supplied by a battery of seven Vapor-Clarkson fully automatic packaged steam generators. Approximately 3300 lb of dry laundry every hour is being processed. This means that 13,333 pieces of dirty laundry will be unloaded at the south end of the newly erected building and within 1.5 hr will come out the other end of the building, washed, dried, ironed, folded, counted and tied in bundles ready for delivery to commissary across the street.

Each of the seven steam generators installed in the U. P. laundry is rated at 4500 lb of steam per hr. Total steam production is 31,500 lb per hr. The speed with which they can be put into operation is illustrated by the fact that each boiler can develope 250 psi in 2 min from cold water. However, the boilers are operated at 100 psi, the pressure required for laundry processing. The steam generators operate at efficiency between 80 and 82 per cent between one-third and full-rated capacity.

The generators are each fired with fuel oil and are completely automatic in operation from one-third to full capacity. A specially designed steam pressure switch starts the fire in one or more units when steam pressure in the line is down, and shuts down when the line pressure is high.

A unified control panel for the seven boilers is located in one corner of the plant. Electric circuits incorporating low-water and steam-pressure limit switches are interlocked through a program relay to control automatic ignition, flame-failure safety device, fuel-burner sequence, motor and oil-heater starters, and dampers that regulate the fuel-air ration. Open limit switches as well as power failure cause instantaneous burner shutdown.

When the 100 lb working pressure is reached, the fire is automatically shut off, but feedwater pump continues to operate the water pump, and when this happens the water automatically by-passes the boiler coils and returns to the water supply. An excessive water-pressure reading on the gage indicates that the coils are in need of cleaning, which is done by making two exterior connection and circulating an inhibited 20 per cent solution of muriatic acid.

Since no large quantity of water is heated under pressure, there is no possibility of the unit blowing up. However, as mentioned above, many safety devices are used to insure safe operation. The feedwater is treated by the "stick" method in a small tank mounted on the base plate of the steam generator.

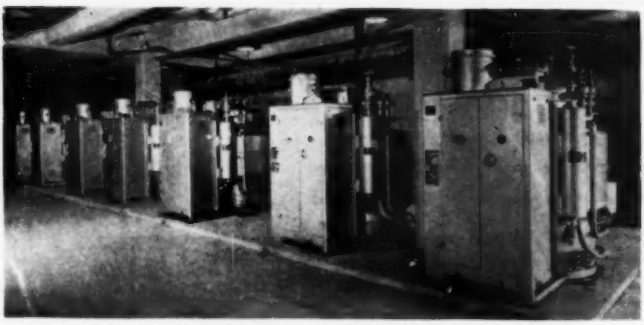
At the Ogden U. P. laundry, the machines are used, not only to heat the water to 180 deg for laundering operations, but to heat the building in winter. Steam developed by the generators is used to operate washers, ironers and pressers. In the basement of the building there are two large heat exchanger tanks, each of 2000 gal capacity. The steam not used in pressers is condensed and re-generated.

About 13,000 gal of water will be used every hour.

Because of the heat generated in laundering operations, the laundry has a ventilating and air-conditioning system which changes the air throughout the building every 90 sec.

Installed at the laundry are eight washers, three extractors, four flatwork ironers, three dryers, 12 tumblers, 42 press units, six folders, one stacker, three tying machines, two continuous belt conveyers and a monorail system for moving baskets. The new plant will take care of linen from all Union Pacific passenger trains, Sun Valley and hotels and restaurants of the system with the exception of the southern Utah parks property of the railroad. A complete dry-cleaning system in the plant will handle drapes and uniforms for the entire railroad.

Engineering for the laundry was done by Union Pacific and Vapor engineers under the supervision of W. C. Perkins, Chief Engineer of the Union Pacific Railroad. L. W. Ashton is U. P. R. Engineer on location. Vapor engineers were N. O. Kirkby and J. E. LaRocque. Construction was done by Larson Construction and Engineering Company, Ogden, Utah.



Arrangement of the seven 4500 lb per hr packaged steam generators. Units can be cut in separately to handle varying steam loads at the laundry

Another Railroad Application*

Another interesting application of the Vapor-Clarkson steam generator is found on the New York Central System. This company installed for the first time a packaged boiler on a railroad pile driver. It produces 3,500 lb of steam per hr at pressures between 75 and 300 psi which is more than sufficient to supply the entire needs of the pile driving outfit even if it were engaged in placing piles by steam jetting. These needs include steam for driving two 12 in. by 16 in. steam engines used in propelling the outfit, for driving a compressor for operating the air brakes, for lifting and turning the pile driver leads, for activating a Vulcan No. 1 single-action steam hammer, for hoisting the piles into place in the leads, and for blowing the whistle.

Manned by a crew of 10 men, this pile driving outfit is comprised of a McMyler-Intrastate pile driver; a tender car with a steel underframe which carries a locomotive-type water tank and a fuel-oil tank; an idler flat car, also a steel underframe, for holding the pile driver lead and tools; and a small trailer push car carrying welding gas tanks and euipment. The total weight of this outfit is approximately 663,000 lb. The steam generator has moved it up a 2.25 per cent grade from a standing start and is capable of propelling it at a sustained speed of from 15 to 20 mph on a level grade.

Pressure Changed at Will

Since the steam generator is more compact and much lighter in weight than the coal-fired boiler it replaced, it was necessary to install counterweights in the cab of the pile driver for balancing the hammer and driving leads. Also in the cab is a 200 gal fuel oil tank which is refilled from the tank on the tender car after each day's work by the engineer of the rig by means of a hand pump, although daily replenishment is not essential. Water is taken directly from the tank on the tender car. Immediately behind the generator are two steam chests which are made to operate at 250 psi; the safety valves are set at this pressure. However, the steam generator is set to cut out at 200 psi and to go on again at 175 psi, and, unlike the former steam boiler, the steam pressure is maintained at 110 to 125 psi while the unit is moving from one location to another. Steam pressure can be changed by adjusting a dial.

A water pump, a fuel pump, a blower and a magneto on the steam generator are driven by a two-cylinder, air-cooled Wisconsin gas engine. The water pumper to the generator is continually turned into steam so that it is not necessary to shut down work operations while feedwater is being added to the packaged steam generator.

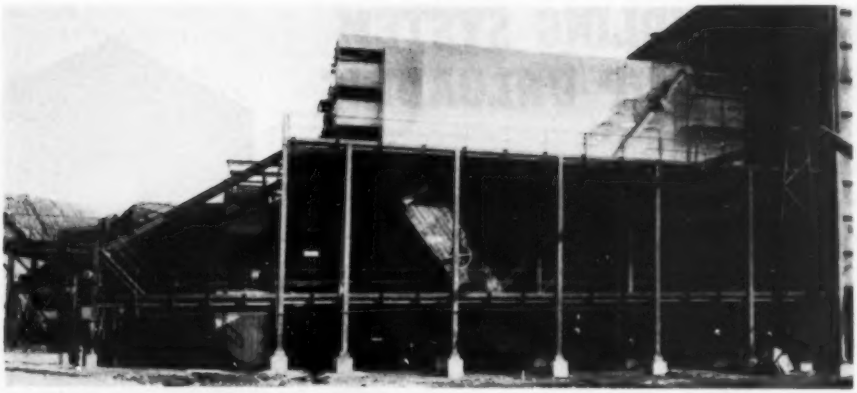
**Information for this application was obtained through the courtesy of the Vapor Heating Corp., builders of the Vapor-Clarkson packaged steam generator.*

New Type Glass Will Aid Electronics

• A new kind of glass which can be precision-machined through the use of ultraviolet light, heat and hydrofluoric acid to form intricately cut patterns of any desired shape and depth was described at the International Chemical Congress in New York City recently by S. D. Stookey, senior research associate of Corning Glass Works.

This new glass is the latest in a series of photosensitive compositions first announced by Corning in 1947 to produce permanent three-dimensional photographs in glass in a variety of colors. To the new composition, which is a special kind of photosensitive opal glass, Corning has adapted an equally new process of "chemical-machining," which produces without the aid of mechanical tools, lace-like patterns hitherto considered impossible in glass.

The versatility of the process has already been demonstrated in the manufacture of "printed" electrical circuits for electronic instruments. It appears certain that this new product will hasten important further advances in the field of electronics.



Over 66,500 sq ft of surface on coal processing units were insulated at 1050 F

INSULATING WHILE HOT PREVENTS EXPANSION TROUBLES

ENGINEERS at the Disco Corp., Imperial, Pa. have solved the problem of expansion cracks in thermal insulation by insulating high-temperature metal surfaces of their carbonizers and roasters at operating temperatures — up to 1050 F. Thermal expansion from shutdown to processing temperatures adds about 8 in. to the length of each carbonizer and 5 in. to the length of each roaster; insulation installed on the huge units while shut down would be very liable to crack and lose some of its effectiveness.

Installed at the plant are seven carbonizers each 125 ft long by 9 ft I. D., and seven roasters each of which measure 6x95x16 ft. These units process over 1000 tons of coal per day to produce Disco, a smokeless fuel from which liquors, tar and gases have been removed. The illustration above shows an insulated recirculating gas duct that leads diagonally from a roaster on top to a furnace below the carbonizer. To maintain the delicate process balances under all weather conditions, a total of 66,500 sq ft on seven such processing units were insulated.

The insulation was applied to all units in 24x48 in. blanket sections. On each of the seven roasters, 5000 sq ft of surface area was insulated with a single layer of a 4 in. thick blanket; average temperature of the metal surfaces was 750 F. Two 4 in. layers were applied to 450 sq ft of surface on each of the seven carbonizers at average temperatures of 975 F. The blankets, composed of mineral wool between metal lath and wire netting, were installed with the wire netting against the heated metal.

The insulating blankets were secured by 300,000 studs, welded to the metal on 9 in. centers. The studs were 5 in. long for the 4 in. thick insulation and 9 in. long for the 8 in. thickness. After all the blanket sections were impaled on the studs, galvanized iron bands were tightly wrapped on 12 in. centers around the carbonizers and roasters to ensure a long lasting insulation cover.

A lock washer was placed over each stud, 1 in. of which protruded above the metal lath permitting the stud ends to be bent over. A 1/2 in. thickness of insulating cement was applied in two 1/4 in. layers over the insulation. The first layer was trowelled into the metal lath and, after drying, the second layer was trowelled over it.

Then sections of 1 in. wire mesh were stretched over the cement and laced together with 18 gage galvanized iron wire. The mesh covering was secured by auto-clench staples driven into the cement on approximately 12 in. centers. As a weatherproof finish, asphalt mastic was trowelled into the mesh covering. The mastic was 1/8 in. thick when dry.

Insulating effectiveness is indicated by the temperature measurements in the table below. The temperatures on the outside insulation surface were measured at three points along a carbonizer and a roaster and compared with bare metal temperatures.

TEMPERATURE MEASUREMENTS ON BARE METAL AND OUTSIDE INSULATION

Point of temperature measurement	*Thickness of insulation, in.**	*Temperature at metal surface, F*	*Temperature on outside insulation surface, F***
Roaster:			
High end	4	900	148
Middle	4	750	123
Low end	4	680	119
Carbonizer:			
High end	8	1050	186
Middle	8	975	161
Low end	8	900	143

*Mineral wool blankets 24 in. wide and 48 in. long.

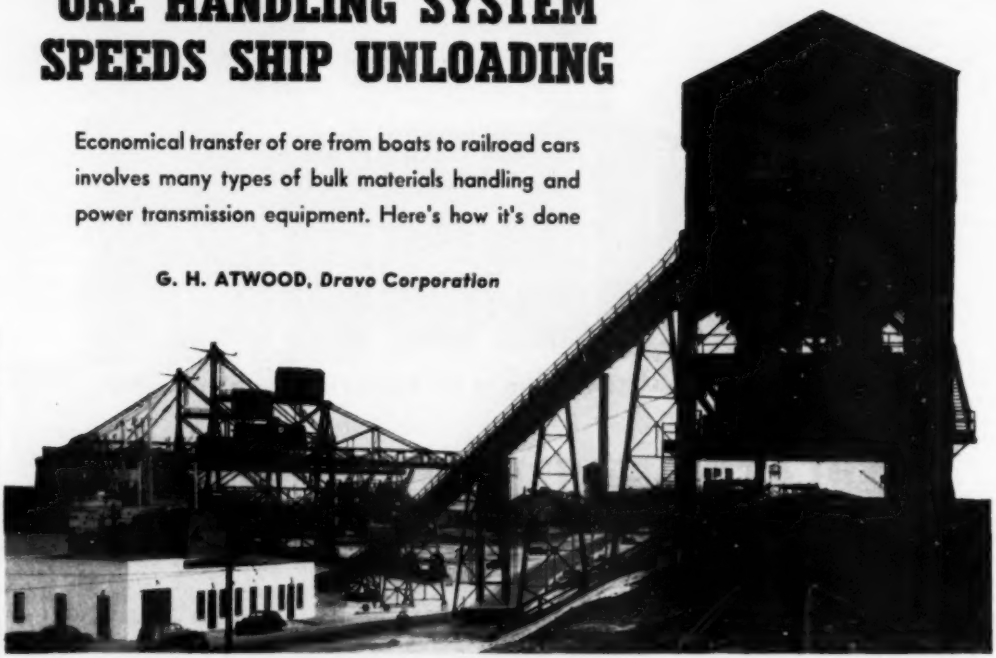
**Measured with mercury bulb thermometer completely insulated except for the tip, which was placed against insulation on the roaster and carbonizer.

NOTE: Information and data in this article were made available through the courtesy of Industrial Mineral Wool Institute, 441 Lexington Avenue, New York 17, N. Y.

ORE HANDLING SYSTEM SPEEDS SHIP UNLOADING

Economical transfer of ore from boats to railroad cars involves many types of bulk materials handling and power transmission equipment. Here's how it's done

G. H. ATWOOD, *Dravo Corporation*



Unloaders transfer ore from ships to belt conveyor, which carries it up to automatic weighing and car loading bin

FOR MANY YEARS engineers and ore operators have watched the increasing depletion rate of the higher grade iron ores of the Minnesota Mesabi range and have recognized the necessity for finding additional ore deposits elsewhere.

The extent to which new unloading facilities on the Eastern seaboard would be required depended upon how much ore would be imported. Officials and engineers of The Baltimore and Ohio Railroad Company had determined that increased unloading and car loading facilities would be needed and announced the decision early in 1950 to construct a huge import pier at Curtis Bay in the Port of Baltimore. The location is immediately adjacent to the railroad company's coal pier where the loading out of coal for water transportation makes available empty railroad cars which can be loaded with ore. Dravo Corporation was awarded the contracts for the ore unloading and ore handling facilities at the new pier, which was designed by Baltimore and Ohio engineers.

By its nature as a common carrier dock, the pier would be required to handle any materials offered from any type of vessel. Accordingly, volume capacities were based upon ore weighing 150 lb per cu ft but all mechanical, structural and electrical parts were designed to handle the same cubic measure of ores weighing 200 lb per cu ft. Gate and chute sizes, feeders and hoppers were designed for granular to 24 in. lump sizes. The problem of ship hatches was met with buckets of 200, 120 and 60 cu ft capacities.

Unloader Operation

Each unloader tower supports a horizontal runway for a man trolley and provides for an overall travel of 200 ft, made up of a front, or water side, cantilever with a working travel of 70 ft from the front legs of the tower, a fixed 65 ft runway through the tower, and a land side cantilever providing rear working travel of 65 ft for dock-side storage.

The front cantilever is in the form of a hinged apron which can be raised to clear ships rigging by means of a single drum, direct-connected electric hoist located in a machinery house at the top of the tower. The apron hoist drum is driven by a 65 hp motor.

The unloader man trolley has two 250 hp, force ventilated hoist motors and two trolley travel motors of 125 hp. Hoisting speed is 250 fpm and trolley travel balanced speed is 1000 fpm. Operating weight of the trolley is 112 tons with an average free digging cycle of 45 sec, transporting 150 lb ore at 1200 net ton per hr.

The bucket hoist consists of two parallel, 34 in. pitch diameter drums, one each for the closing and holding motors. In hoisting, both motors operate simultaneously. The trolley is spring mounted on four 33 in. diameter tapered tread, single flanged wheels. Each axle is driven by a single cradle mounted motor. On the trolley deck is a ring type turntable for rotating the smaller buckets. It consists of a cast turntable ring with vertical and horizontal rollers and a bevel rack for driving. A 6½ hp motor produces a turning speed of 9 rpm on the turntable ring. Wedge type rope sockets hold each bucket, which has its own separate set of ropes.

Bucket Equipment

The bucket for normal digging at high rate is a four-line type, reeved eight parts in the closing for power and moderate speed necessary for good performance when digging large and lumpy ores. The smaller buckets are the toggle link type, reeved in the bight of the line and utilizing six parts.

Operating weight of the entire tower

is 685 ton. Each corner is carried on eight 30 in., fully equalized, single flanged wheels, traveling on 171 lb track rails on 2 ft 6 in. centers. All eight wheels on each corner are driven by a 33 hp motor through worm gearing, universal joints and flexible couplings, with one worm set for each four wheels.

Four rail clamps for each tower hold it against a wind pressure of 40 psi. Clamps may be set in an emergency at the will of the operator, by power failure, or by operation of the anemometer which cuts off power at a predetermined wind velocity and applies brake and sets clamps. A 160 ton surge hopper delivers ore to the feeder under each unloader. Ore flow is regulated by a ratchet operated gate which, when set, determines the depth of ore on the feeder. The feeder itself is powered by a 15 hp variable speed motor and rate of feed to belt may be varied from 665 to 1330 ton per hour when handling 150 lb ore. Rubber impact idlers are mounted on feeder supports and carry the main conveyer belt at any loading point. A special arrangement of chutes, skirts and fingers permits finer material to reach the belt first so that larger lumps will fall onto a moving bed of finer material, giving longer belt life.

The main belt is 48 in. wide, travels at 400 fpm and handles 2000 ton of ore per hr. It is 9 x 11 ply with 1/4 in. top cover with breaker strip and 1/16 in. bottom cover.

The conveyer has a total length of approximately 895 ft, travels horizontally along the dock beneath the two unloaders, rises along a vertical curve of 525 ft radius and ascends on a slope of 16 deg to the discharge bin.

A 200 hp motor powers the primary belt drive and a 100 hp motor the secondary drive. Drive pulleys are 72 in. diameter; tail pulley, 66 in.; snub pulleys, 36 in.; and take-up pulley, 48 in. Main drive pulley and secondary drive pulley are provided with vulcanized lagging and herringbone grooves. A vertical counterweighted take-up is employed, midway along the inclined portion. Primary drive for the conveyer is located in the drive room above the discharge bin.

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Electrical Power

Power for operation of the equipment is 230 v d-c. Main power supply to the site is 13,200 v a-c carried into a sub-station furnished by the railroad. Transformation and tube rectification produce the required d-c voltage.

Full magnetic control is used generally throughout the entire system and necessary safety interlocking and limit switch protection is provided.

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The main conveyer may be stopped and started from the conveyer drive house and from the scale house below, while unloader feeders may be operated from the man trolley operator's cab or from a station on the tower at dock level. The main belt and unloader feeder are interlocked so that stopping of the main belt will stop the apron feeders, which may not be started unless the main conveyer is running. Colored indicating lights show the operator that unloader feeders are running, or from which point the feeders were stopped.

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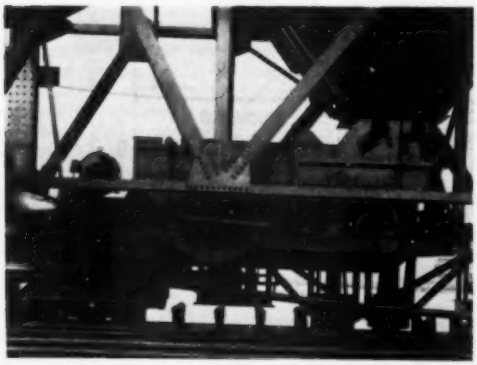


Conveyor feeder mounted on unloader raises belt on rubber impact idlers and drops finer material first to cushion fall of lumps. Conveyer discharge is regulated by feeder

Two motor system operates conveyer, which uses the largest single-piece belt made. D-c power drives the 900 ft conveyer along the pier and up the 16 deg slope to the discharge bin

MORE HORSEPOWER PER ENGINE BY COOLING

Precooling cylinder air of supercharged diesel engines, having proved so successful in increasing horsepower ratings, lead to the design of a diesel incorporating these features. Supercharged diesels operating in warm climates now have ratings corresponding to DEMA standards

R. H. MILLER, *Chief Engineer*
Four-cycle Engine Department
Nordberg Manufacturing Co.

ONE OF THE more important advances made in obtaining increased diesel power output is the application of supercharging. The advantages result from the fact that more air can be forced into the cylinder than is possible with a naturally aspirated engine, and more fuel can be burned with a resultant proportional increase in power at no higher combustion temperature. One of the factors that makes this possible is a considerable amount of air cooling is obtained by allowing cool intake air to blow through the cylinder during a part of the exhaust and early part of the intake strokes, thus carrying out more exhaust heat.

By increasing the power through supercharging, a given engine will have less weight per horsepower, more power for the space occupied, will cost less per horsepower for engine and its installation, and will have an improved fuel consumption over the entire range. Usually a turbocharger is driven by the exhaust gases and requires no power from the engine.

Most modern designed diesel engines, although structurally able to carry far greater horsepower, have reached the point where their safe rating for continuous service is determined by the ability of the surfaces in contact with the combustion gases to stand the temperatures without heat failure or destruction of piston ring lubrication. Non-supercharged, four-cycle engines of modern design are rated at about 80 psi bmep while low pressure supercharged engines operate at about 120 psi bmep in continuous service.

The Diesel Engine Manufacturers Association Standards provide that engines shall be rated on the basis of 90 F intake air conditions. To maintain the same average combustion temperature and heat load to the cooling water it is necessary to reduce the engine rating about 3 per cent for each 10 deg in intake air temperature above 90 F. It follows therefore that engine rating can be increased about 3 per cent for each 10 deg below 90 F.

High intake air temperature affects the engine rating in two ways. First, there is less air available to burn the fuel because the density and weight of air in the cylinder decreases with increasing temperature; and second, the average temperature during the combustion stroke increases about 2 deg for each degree increase in intake temperature. Thus, less fuel can be burned

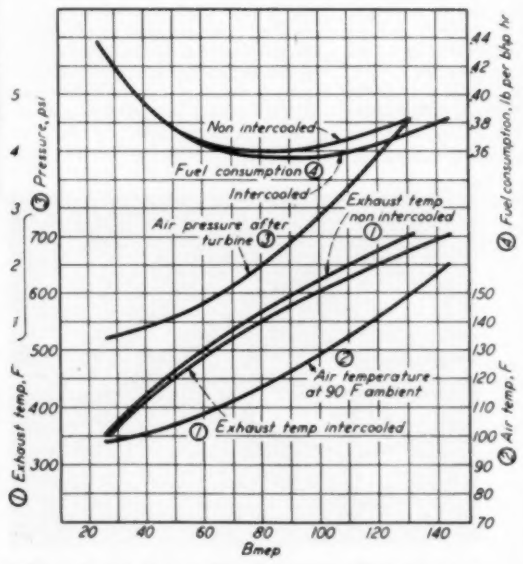


Fig. 1—Curves indicate the performance of four-cycle supercharged diesel engine when intake air is cooled with water

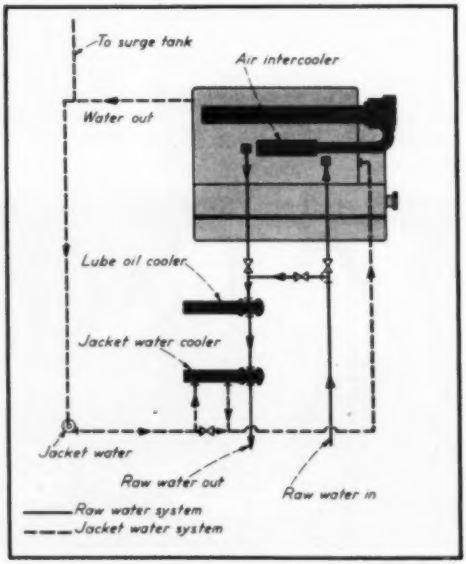


Fig. 2—Typical schematic arrangement of jacket water piping for intercooling intake air of supercharged diesels

CYLINDER AIR

(less horsepower produced) before the maximum safe temperature is reached.

The low pressure turbo-supercharged diesel engine could be rated 15 per cent higher with equal conservativeness except for the fact that in increasing the air pressure to 3½ or 4 psi, the intake air temperature rises from 90 F at the blower intake to about 140 F at the blower discharge. This higher air temperature detracts considerably from the advantages of 3½ to 4 psi air.

The next step in increasing the rating is to cool the intake air after it leaves the supercharger. If cooling water should be available at a temperature that would permit bringing the intake manifold air temperature back to 90 F, the rating of the engine can be increased 15 per cent with no increase in average combustion temperature or heat load to the water jackets. This can be done by a simple, finned tube type of air-to-water heat exchanger built into the engine and through which the cooling water is circulated before going to the engine jacket water cooling system.

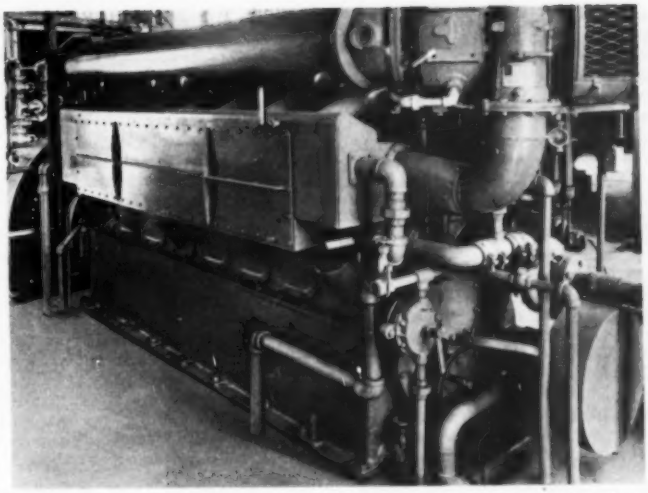
Increased Rating

An economical design of intercooler will reduce the intake manifold temperature to within 15 deg of the water temperature. Thus, 90 F water to the intercooler will result in 105 F air temperature to the engine. Since the normal rating of the low pressure supercharged engine is based on 140 F air temperature to the engine the use of the intercooler permits an increase in rating of 10 per cent.

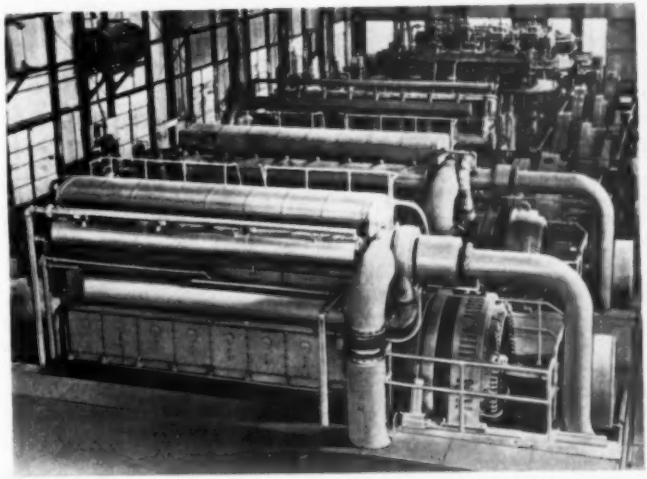
While a non-intercooled engine must be derated for intake air temperature above standard conditions of 90F the intercooled engine is independent of intake air temperature, and its rating is determined by the water temperature to the intercooler. For example, a non-intercooled engine installed where summer temperatures reach 110 F must be derated 6 per cent in horsepower under these conditions.

The effect of supercharging and intercooling on the ratings of 16 in. bore, 22 in. stroke, 327 rpm, four-cycle stationary engines is shown in Table 1. The rating shown for the supercharged, intercooled engines is based on 90 F water to the intercooler and 105 F air temperature in the manifold.

The curves in Fig. 1 indicate the effect of intercooling on four-cycle supercharged engine performance. A schematic arrangement of the jacket and raw water cooling systems of a



Supercharged four-cycle 720 hp diesel engine that has been equipped with a finned tube type of air-to-water heat exchanger. Each 10 deg that intake air to combustion chamber is cooled below 90 F increases the engine rating 3 per cent



These Supairthermal diesels, each rated at 2100 hp, are installed at Fernandina, Fla. They are operated by the Florida Power Company at maximum efficiency and rating even during extreme warm weather. Intercooling is incorporated in design

TABLE 1—TEST RESULTS OF SUPERCHARGING AND INTERCOOLING

Number of cylinders	Non-supercharged 80 bmep, bhp	Supercharged 120 bmep, bhp	Supercharged intercooled 132 bmep, bhp
5	730	1090	1200
6	875	1310	1440
7	1020	1530	1680
8	1165	1750	1920

supercharged intercooled engine is illustrated in Fig. 2.

At one particular plant, power losses due to both high altitude and high temperatures were compensated by the use of intercooling in conjunction with a slightly higher supercharged pressure. These engines are installed at an altitude of 3500 ft. This would normally require that they be derated 8 per cent due to the lower density of the air. An additional loss of 4½ per cent results from air temperatures of 105 F during the summer. To compensate for these losses, totalling 12½ per cent of the engine ratings, superchargers were designed to give a higher manifold pressure. While the higher supercharger pressure restored manifold air density to sea level conditions it caused the air temperature in the intake manifold to increase to 188 F, and this would have cancelled all of the benefits of the higher pressure. An intercooler using 125 F water reduced the manifold air temperature to 140 F. With air density and temperatures restored to normal sea level conditions no derating was necessary. The same intercooler supplied with 90 F cooling water would permit rating the engines at 10.5 per cent above normal rating for 90 F air and sea level conditions.

There are many applications where intercooling can be used to provide an increase in horsepower at small additional cost and without any increase in space or foundation requirements. Water for intercooling can be either fresh or sea water. The latter is particularly advantageous where engines are installed in tropical climates.

Nordberg engineers realizing the advantage of intercooling supercharged diesel engines have developed a four-cycle supercharged unit that embodies these features. It is capable of operating on fuel oil, dual fuel and spark-fired gas.

Most notable characteristic is the ability, in any given size, to produce one-third more horsepower than the conventional supercharged engine with no greater heat to the cooling water and without increasing the internal surface temperatures or pressures.

The intercooling system, a finned tube type of air to water heat exchanger, is built into the new engine. Cooling water passes through this exchanger before it enters the regular jacket water system. Intake air temperatures are maintained at 90 F, which is the DEMA standard for rating diesel engines.

Turbocharger is driven by the exhaust gas and requires no power from the engine. At rated full load, it delivers air to the intercooler at 15 psi. The point at which the intake valve closes during the intake stroke is automatically controlled by the pressure in the intake air manifold. For example, with a 15 psi manifold pressure, which is normal at full rated load, the intake valve closes 45 deg before the end of the intake stroke. This is an important difference over that of the conventional supercharged engine where the intake valve remains open until the end of the intake stroke.

Air in the cylinder is expanded from 15 to 6 psi as the piston continues downward to the end of the stroke. Because of this expansion, the temperature drops from 100 to 50 F. As the manifold pressure decreases at part loads, the intake valve closes later so that the air pressure at the beginning of the compression stroke remains 6 psi. At light loads where the intake manifold pressure is 6 psi or less, the closing of the intake valve is fully retarded and the pressure and temperature at the beginning of the compression stroke is the same as in the intake manifold after the intercooler.

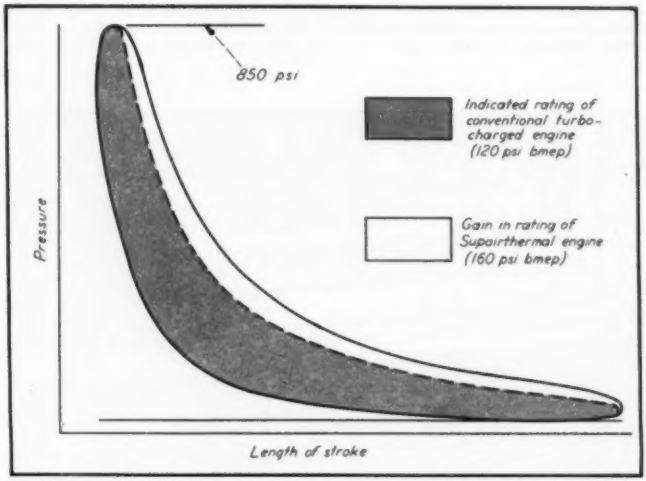
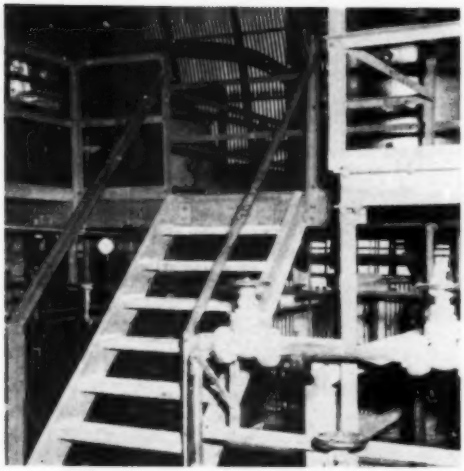

850 psi
Indicated rating of conventional turbo-charged engine (120 psi bmep)
Gain in rating of Supairthermal engine (160 psi bmep)
Pressure
Length of stroke

Fig. 3.—Composite indicator diagram of a conventional supercharged diesel and new unit. White area shows increase in amount of work done by the improved engine

TABLE 2—PERFORMANCE COMPARISON BETWEEN SUPERCHARGED NON-INTERCOOLED AND SUPAIRTHERMAL ENGINES

	Supercharged (non-intercooled)	Supairthermal Engine
Engine bore and stroke, in.	13 x 16½	13 x 16½
Rotating speed, rpm	450	450
Piston speed, fpm	1237.5	1237.5
Maximum firing pressure, psig	850	850
Brake horsepower for continuous service	150	200
Brake mean effective pressure, psi	120	160
Ambient temperature, F	90	90
Air temperature supercharger discharge, F	142	250
Air temperature to intercooler, F	—	250
Water temperature to intercooler, F	—	90
Air temperature after intercooler, F	—	100
Air temperature entering engine, F	142	100
Air temperature start of compression F	142	50
Air pressure supercharger discharge, psig	4	15
Air pressure entering engine, psig	4	15
Air pressure start of compression, psig	4	6
Heat to cooling water		
Btu per min per bhp	16.20	12.15
Total Btu per min at above rating	2430	2430
Heat to lubricating oil		
Btu per min per bhp	6.66	5.80
Total Btu per min at above rating	1000	1160
Heat removed by intercooler		
Btu per min per bhp	—	8.2
Total Btu per min at above rating	—	1645
Fuel consumption lb per bhp per hr		
Full load	0.375	0.369
¾ load	0.370	0.355
½ load	0.375	0.365
Mechanical efficiency, per cent	83.2	85.4



Main and firing decks at the Flagstaff power plant. The upper deck contains turbine generator and switchgear panels

WASTE PRODUCTS GENERATE POWER

Sawmill waste timber products fired at the various power stations of the Central Arizona Light & Power Co. supply enough steam to generate two-thirds of the electric power that annually reaches 50 million kwh. Plans call for additional power generating units to be set up, and ultimately 90 per cent of waste timber in Arizona will be converted to power

JOHN L. PARKER, Consultant

NEARLY 50 MILLION kwh of salable power is being generated yearly in Arizona's northern forests by burning the waste timber products from sawmills handling the largest stand of Ponderosa pine on the continent. At present two-thirds of the power is generated in plants owned by the Central Arizona Light & Power Co. of Phoenix and its wholly owned subsidiary company, Northern Arizona Light & Power of Prescott, Ariz.

Generating plants are located at McNary and Flagstaff, Ariz. These were built by the Southwest Lumber Mills, which company has sawmills at both towns. Early this year the two utilities purchased these plants for $1,250,000 and spent an additional $200,000 to bring them up to maximum generating capacity. Another $1,000,000 was used to improve transmission lines, extend service and install various connections between the generating plants in the woods and the main steam plant at Phoenix. In addition to its own waste power generation at Flagstaff, Northern also buys 20 million kwh yearly from the Saginaw and Manistee Lumber Co.

Favorable Costs

While most mills generate at least part of their own power from waste products, this is one of the first instances where power companies have taken over the actual operation of the waste fuel generating plants to produce a huge volume of power in excess of sawmill needs. Through improvements in both distribution and generation, the cost of waste fuel power compares favorably with the most modern low cost steam plants. Further as the power generation units are set up in Arizona, nearly 90 per cent of all waste timber produced in the state is being converted to valuable power.

High Btu Content

Arizona production is from 175,000 to 200,000 board feet of finished lumber during the year. The bulk of the cut is Ponderosa (white) pine, a fast free burning wood. The percentage of waste in a log varies from 40 to 70 per cent of the board feet. The average number of Btu's for each board varies from a high of 21,800 for sawmill waste to a low of 8080 for box factory waste; the latter is composed mostly of light shavings as against bark and heavier parts from the sawmill.

The Flagstaff generating station is a modern plant completed in 1948, and waste fuel is supplied from the sawmill, planing mill and box factory. The mills operate 9 hr per day. The plant built by McNanama and Co. of Seattle Wash. is equipped with two 700 hp three-drum Stirling type vertical water-tube boilers with radial tile ignition arches. The boilers feed steam at 250 psi to a steam turbine driving a 3000 kw generator producing 60 cycle current at 2300 v.

Boilers are dual type units, each equipped with oil burning jets, which can be turned on in case of a waste wood fuel shortage caused by any prolonged shutdown of the mill. Emergency fuel oil storage is kept in two raised 11,000 gal tanks that are isolated from the plant and mill.

Sawdust and scrap is picked up in a trough running the full length of the outside of the sawmill building and conveyed to a grinder called a hogger. Sawdust by-passes the hogger by dropping through a stationary screen and onto the conveyer feeding boilers. The hogger grinds the broken pieces, such as flitches and bark, coarse material picked up by the planing mill blower system and the waste from the box factory into chunks not larger than 2 in. Hogged fuel is dropped onto the feed conveyer and is fed through chutes on the firing deck into the fireboxes. Diversion gates on conveyer belt control the feed rate. Combustion is almost 100 per cent, and there is very little ash.

Stockpiling

Fuel not fed to the boilers is reconveyed to a stone storage bin. When the bin is filled, fuel is stockpiled under an overhead conveyer extending out several hundred feet from the storage bin. The company has found this conveying circuit the most effective method of thoroughly mixing the hogged fuel and sawdust prior to storage. Stored fuel is fed to the boilers only during the 15 hr the mill is down through a reclaiming tunnel and conveyer. A dozer equipped tractor keeps the stockpile level and compressed.

Saginaw's plant is housed in an all steel building, which was erected in 1948 by McNanama & Co. While the handling of fuel is very similar, the equipment is different.

Generating equipment consists of two high-speed turbine-generators built

Flagstaff power unit is housed in this modern steel structure with quonset hut roof at the base of Arizona mountains

McNary sawmill and power plant are housed under one roof. Approximately 49 per cent of each log is burned as waste

for Navy use in destroyer escorts and sold as surplus. The units are rated at 4600 kva when operated at the high speeds considered efficient in the Navy. For Saginaw's power requirements the units are slowed to produce 2250 kw each and are rewound for 2400-v operation.

A single boiler of Stirling water-wall type rated at 1250 hp at 450 psi, 460 FTT, delivers 60,000 lb of steam per hr to drive the generators. A low pressure station on the steam line makes it possible for the company to continue using two smaller turbine generators operating at 200 psi. These two units, which generate 1500 kw, are giving excellent service after 30 years of almost continuous operation.

In the extreme northeastern end of Arizona and at an altitude of 7300 ft, is located the McNary plant, which is the largest steam generating unit in the west firing waste fuel.

Boiler equipment includes three 500 hp vertical water-tube boilers with fans and motors, two 550 hp water-tube boilers with fans and motors, a 900 hp Stirling water-tube boiler and a 1250 hp vertical water-tube boiler equipped with a 90,000 cfm induced draft fan.

Generating equipment includes 1250, 3000 and 4000 kw a-c turbine-generators. D-c power in the amount of 100 kw is generated by one turbine and two MG sets.

A total of 1016 ft of belt conveyers in the plant and fuel storage yard handles the sawdust, hogger product and waste from the moulding plant and planing mill.

By extending a transmission line 15 miles from McNary to Showlow, Ariz. Calapco was able to connect with its subsidiary, Northern Arizona Light & Power and send power over the line to supply eight communities between Flagstaff and McNary with power from either end. The combined companies were also able to retire a small, high cost steam generating plant near Prescott, Ariz, to a standby basis.

Both plants supply power to the Southwest Lumber Co. mills and factories. Power is discounted to the lumber company at the rate of 3 mills per kw as full payment for the fuel supplied by the lumber company. Both plants supply steam for use in the sawmills. This totals 68,000 lb per hr at McNary and 25,000 lb per hr at Flagstaff. The rate is 0.25 and 0.30 per 1000 lb.

The Cover—Compressors for Nitrogen Production

• The colorful display of heavy equipment on this month's cover are Cooper-Bessemer Type JM motor-driven compressor units, each rated 2250 hp at 300 rpm, installed in a large west coast chemical plant engaged in the production of ammonia.

In this plant colors serve a useful purpose. The body of the compressors are painted a gray green, the water lines dark green, oil piping orange, and control wheels gold. The unit in the foreground is a nitrogen compressor with the nitrogen headers painted a dark blue. Behind it is an air compressor the headers of which are painted a dark green while the other two units are gas compressors with the gas headers painted yellow.

Nitrogen-rich liquid ammonia, four-fifths nitrogen, is gaining widespread acceptance as one of the richest, most inexpensive and effective fertilizers ever discovered for feeding soil the nitrogen needed for healthy bumper crops.

Ammonia is generally made by extracting nitrogen from the air and mixing it with hydrogen taken from natural gas and water. This extraction is accomplished through a high pressure compression process in which the illustrated compressor units play a vital part.

INDUSTRY AND POWER acknowledges cooperation of The Cooper-Bessemer Corp. in making the four-color illustration available.

SYNCHROTIE DRIVES IN PROCESS INDUSTRIES

J. G. HOWELL, Jr., *Electrical Engineer, Owens-Illinois Glass Company*

DESIGN FACTORS IN APPLICATION OF SYNCHROTIE SYSTEMS

1. The speed range of the operation.
2. The normal torque and horsepower requirements of the receivers when referred to the receiver running speed.
3. The severity of any pulsating torque loads.
4. The added mechanical load of the transmitter when operating against the field.
5. Would any elements of the operation be damaged by sudden reversal or by running away in the forward direction at synchronous speed?
6. What means can best prevent damage due to loss of synchronism and consequent run away in either direction?
7. What are the starting torque requirements?
8. To what extent should the synchrotie system be interlocked with the main drive motor?
9. Will it be desirable at any time to disconnect one receiver of a multi-receiver system?
10. Will speeds be so low as to necessitate forced cooling of the motor with air from external source?
11. What will be the ambient temperature?

SYNCHROTIE, as the name implies, is a method of synchronizing equipment by electrical means. The synchrotie system may provide the actual power to drive one machine in synchronism with another or it may provide only sufficient power to operate speed control devices. In either case, the synchrotie does electrically what gears and jack shafts do mechanically — making one machine element run at the same speed as another, regardless of how the speed may be varied.

Elements of a synchrotie system are two or more wound rotor induction motors with suitable control equipment. One motor, the transmitter, is connected to and driven by a machine whose operating speed is varied. The transmitter is, in effect, a generator of variable frequency. The other motor or motors, the receivers, are mechanically connected to drive machine units which are to be synchronized in speed with the driving machine.

Slip rings, Fig. 2, of the receivers and transmitters are connected in parallel. Stator terminals, also in parallel, are connected to lines of a 3 phase a-c power supply. Electrical characteristics of all rotors must be comparable as to voltage and current ratings, or capable of correction by transformers in the rotor circuits.

At zero speed, phase and frequency of induced rotor current are the same as for the power applied to the stators, say 3 phase, 60 c. When the transmitter rotor is turned, frequency of the induced rotor current will be less or greater than 60 c depending on speed and direction of rotation. As this frequency is transmitted to the receiver, the latter attempts to lock in synchronism with the transmitter.

With direction of rotation the same as the magnetic field of the stator, induced frequency is less than 60 c and the rotor turns "with the field". Conversely, rotation "against the field" induces a frequency greater than 60 c. There are important features to each type of operation.

Control devices usually apply single phase power to the synchrotie system when starting, then three phase power before the main drive motor of the variable speed machine (which drives the transmitter) is energized. For best results, this entire operation should be automatic with a single start button.

In the glass container industry, synchrotie systems are used to synchronize speed of a lehr loader and conveyer with that of a gob feeder and a bottle machine. They eliminate various mechanical linkages previously used, along with inherent installation and maintenance problems.

Although relatively simple, the apparently unpredictable behavior of the synchrotie system has caused trouble. For example, a receiver motor driving a machine may, without warning, either suddenly stop or run as a straight 60 c induction machine in the forward direction. It may even reverse direction if connected to run against the field or

refuse to start when the transmitter drive is started.

However, the synchrotie system can be a simple, dependable speed transmitting device when applied with full cognizance of fundamental characteristics and with proper maintenance.

Speed, Torque Are Important

Typical curves for a 5 hp, 4 pole wound rotor motor operated as receiver or transmitter are given in Fig. 1. Right of the zero speed line, direction of rotation is with the field; to the left, rotors are connected to turn against the field. The upper curves give pull-out torques or values at which synchronism will be lost. The bottom curve represents limits of continuous running torque as established by motor temperature. At low speeds, the self-cooling effect is less and motor currents must be reduced by using lower torques.

To transmit maximum horsepower when torque is limited, speed must be as high as is practicable within the limits of the available torque at that speed. For operation with the field, Fig.1 shows that top rotor speed is approximately two thirds synchronous speed, or 1200 rpm. Above this point, pull-out torques drop rapidly. For stability reasons, it may be desirable to reduce the maximum speed to about 1100 rpm, where a 5 hp receiver can deliver continuously approximately 2.9 hp, based on a torque of 14 ft-lb from the bottom curve. Receiver pull-out horsepower at 1100 rpm is equivalent to 49 ft-lb of torque, but pull-out torque is only 10 ft-lb for the same size transmitter.

For operation against the field, the only limitation on speed is centrifugal force for which the motor was designed, which, for standard construction, is approximately 125 per cent of rated synchronous speed. The higher pull-out and safe continuous torques, together with the operation at higher speeds allow transmission of greater horsepowers and often make against-the-field operation attractive.

Against-the-Field Troubles

However, operation against the field has objectionable characteristics which have caused engineers to avoid its use (except in special cases) in favor of operation with the field. Reasons for this preference are:

1. When a receiver connected against the field pulls out of step, it immediately stops, and accelerates as an induction motor to approximately synchronous speed in the reverse direction. This can be disastrous unless adequate safeguards are applied.

2. With against-the-field connections the transmitter absorbs about 50 per cent more mechanical power than

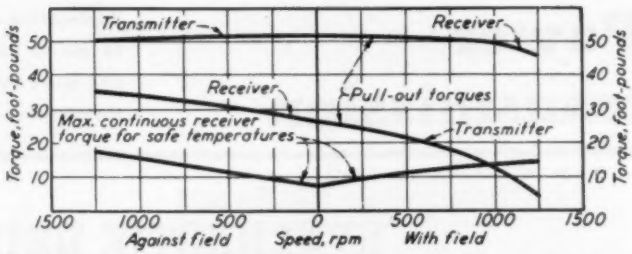


Fig. 1—Upper curves show maximum pull-out torques. Note that transmitter and receiver characteristics shift from one curve to the other when field or rotor direction is reversed. Bottom curve is maximum torque for safe temperature rise

is transmitted by the receiver. Although the additional power absorbed is returned to the line as electrical energy, it must nevertheless be delivered mechanically to the transmitter, putting a greater load on the main drive motor, its speed control and connecting drive.

3. Starting torque of the receiver is not as high when connected against the field, and low speed starting may be required if receiver inertia is large.

Largely because of the above reasons, operation with the field rather than against the field is most generally used. However, for installations where instantaneous speed of the main machine fluctuates widely, due to reciprocating or intermittent action of some heavy part, synchrotie operation with the field can result in frequent loss of synchronism even though speed is well within the limit. Efforts at improving the situation have included methods given in Table 1.

Some of the corrective methods are not always practicable. For example, a flywheel may overload the mechanical parts of the drive, or there may not be enough space for larger drives or more transmitters. On the other hand, removing excess play is good maintenance. Forced cooling lowers motor resistance and results in higher rotor currents and greater stability. Forced cooling also prolongs the life of motors in high ambient temperatures such as found in the glass container industry.

Pulsating Loads

For pulsating torque loads, however, one of the simplest means of obtaining greater stability from an existing synchrotie system is to reconnect it to operate against the field. This is because stability under pulsating conditions is a function of both the transmitter and receiver pull-out torques, Fig. 1, and not of receiver torque alone.

For example, when a transmitter connected to operate with the field is momentarily slowed by pulsating action of the driving machine, momentum makes the receiver act as a transmitter and attempt to drive the normal transmitter. It is only restrained from doing so by the maximum torque it can handle as a receiver. At 1100 rpm, this is shown in Fig. 1 to be only 10 ft-lb or about one fifth of the pull-out torque as a receiver. Thus, if momentum of receiver and its machine is appreciable and speed change of the

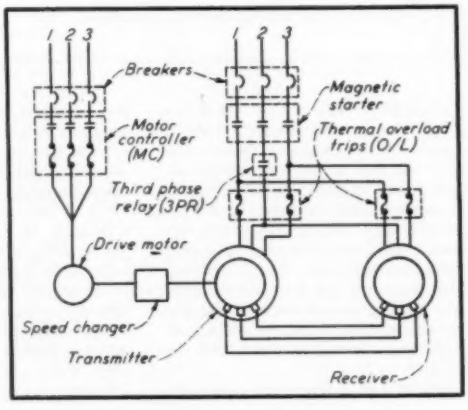


Fig. 2—Synchrotie drives may use two standard wound rotor motors with slip rings connected, and stators paralleled on a polyphase line. This circuit includes third phase switch for accelerating the equipment as single phase induction motors until running speed has been approached

TABLE 1—METHODS OF IMPROVING WITH-THE-FIELD OPERATION

1. Flywheels on drive motor to smooth out the pulsations.
2. The installation of larger synchrotie elements.
3. The installation of a transmitter for each receiver where two receivers had formerly been operated by one transmitter.
4. Larger main drives to smooth out the speed fluctuations.
5. The provision of external cooling for the synchrotie motors.
6. The reduction of any slack or play in the connecting gears, chains, couplings, etc., in the machine elements.
7. The application of 10 and 15 per cent higher voltages to the synchrotie motors to increase the available torque.
8. The reconnection of the units to operate against the field.

TABLE 2—SUMMARY OF CHARACTERISTICS FOR AGAINST-THE-FIELD OPERATION

Advantages:

1. Greater stability for pulsating torque speed conditions.
2. No restrictions on receiver speed.
3. Greater horsepower can be transmitted by the receiver.
4. A simple means can be applied for stopping the system instantly in the event of pull-out.

Disadvantages:

1. Increased torque load on the transmitter's drive.
2. Lower starting torque.
3. Slightly greater power loss due to heavier transmitter loading and higher rotor frequency.

transmitter is large, the system falls out of step because the transmitter torque characteristic is too low.

At 1100 rpm with operation against the field, pull-out torque is 50 ft-lb, or 5 times as great. Also, it is practicable to increase the speed up to 2200 rpm, further increasing stability by the ratio (2 to 1) of speed increase for a total gain in stability of 10 times.

Reversals which occur in against-the-field operation when the receiver does lose synchronism can be prevented by the application of an anti-plugging switch to the receiver. This is connected to de-energize the control circuit of the entire system, including the transmitter drive motor, at the moment the receiver motor stops and before it can turn in the reverse direction. Application of an anti-plugging switch is much simpler than the overspeed devices required to prevent runaway damage when the system is operated with the field.

Advantages and disadvantages of against-the-field operation are summarized in Table 2.

Synchrotie Controls

For successful synchrotie system operation, careful attention must be given to design of control and power circuits. Fig 3 shows a simple control Circuit for operation with the field. It also may be used for operation against the field provided sudden reversal of the receiver motor would not be serious. In this circuit, the synchrotie transmitter and receiver first receive single-phase power to facilitate synchronization, then 3 phase power is applied and finally the drive motor is energized. The rotary selector switch allows operation of the drive motor alone without the synchrotie units.

Fig. 2 gives power connections for a simple synchrotie system. While the line contactors are common to both receiver and transmitter, each unit has its own pair of thermal overload elements. If receiver and transmitter are to be operated close to full rated speed, heater elements can be selected for the full load ampere rating of the motor, less approximately 15 per cent to allow for increased heating of the rotor due to the higher frequency. Where units are operated at less than full speed—say 1000 to 1200 rpm for operation with the field—then the rating of the heater elements must be reduced for proper running protection.

Heater Recommendations

The reduced rating should be obtained from the motor manufacturer or estimated from the rating assigned to the same frame size for the speed used. Actual winding temperatures of existing installations can also be determined by direct measurements.

If the system is to operate at horsepower loads above the continuous permissable torque curves, forced cooling should be applied and overload heaters corrected accordingly.

Fig. 4 gives a control circuit for operation against the field. An anti-plugging switch is included for reversal protection.

Where the machines are to be stopped frequently and close indexing between the machines is essential, power on the synchrotie unit may be maintained long enough after the drive motor is de-energized to permit the machines to come to rest in synchronism. This may be done with a time delay relay in the synchrotie controller circuit where operation with a single pushbutton control is desired.

However, when the machine driven by the receiver tends to coast longer than the transmitter, and when the drive motor is stopped with the synchrotie units still energized, the receiver becomes a transmitter and may or may not drive the main machine. Operation against the field may be the simplest insurance of maintaining register because of the greater stability obtained.

Another solution to heavy inertia forces uses an adjustable torque brake on the machine driven by the receiver. The brake is applied the instant the main drive motor is stopped and is adjusted so that, when de-energized, the machine driven by the receiver will come to a stop before the transmitter. When energized while stopping, the receiver continues to act as a receiver, with little danger of the units pulling out of step. Use of the torque brake will often permit operation with the field where heavy inertia forces are involved.

Other variations in control and power circuits for synchrotie systems include (a) circuits which permit selecting an individual receiver of a multi-receiver installation, with or without stopping the other receivers, and (b) circuits which permit individual receivers to operate separately as wound rotor induction motors with speed control through variation of external rotor resistance.

Installation And Maintenance

Planning the wiring for the system will help assure simple and easy connection of all units. Some engineers color-code all six wires to the synchrotie motors to facilitate "phasing-out". Others have found one color for the stator and another color for the rotors adequate.

Required wire size for rotor connections should be determined from the manufacturer's rating data. Where long leads are required for rotor connections, the next larger size may be desirable since rotor circuit resistance affects stability.

Synchrotie systems require slightly more attention than simple motor and controller installations. For example, a small amount of dirt under one slip ring brush can cause this circuit to become predominantly single phase and receivers may start and run as induction motors when the stators are energized. A loose brush connection or spring or a brush binding in its holder will often have a similar effect.

Special precautions are necessary to keep the rotor brush and slip ring

equipment clean. Totally enclosed, dust-tight equipment may be an answer. Advantages of separately ventilated units should not be overlooked. However, even with ideal cooling systems, regular inspections should be made of all synchrotie brushes and slip rings.

Electrical Maintenance

Brush contact resistance readings between the slip ring and brush terminal, as well as rotor circuit resistance readings, should be made on both transmitter and receiver if trouble persists with any particular synchrotie system.

Generally, the controls need no more than regular care. However, for systems with individual pushbuttons to energize the synchrotie system and main drive motor separately, failure of the synchrotie control or of the single phase relay to close is not always apparent. Thus the main drive motor could be started without proper response from the synchrotie system, a reaction not unlike that from dirty slip ring brushes.

Another advantage for the single pushbutton control is that the synchrotie elements cannot be left energized when the drive is shut down and cause eventual burnout.

Even where good electrical maintenance exists, the electrical department is often blamed for synchrotie failures primarily due to mechanical troubles. If ammeters are not permanently installed, readings during normal operation should be taken with hook-on or other portable ammeters for the line currents to transmitter and receiver as well as for rotor current. When trouble persists, comparison of the new readings against the normal valves will indicate extent of any mechanical derangement. However, if readings in any of the three legs of the rotor or line conductors differ, electrical trouble is definitely indicated.

Torque and Voltage

Since torque capacity of synchrotie systems varies with the square of the voltage, a 10 per cent drop can cause a 19 per cent drop in pull-out torque. It may be advisable to connect the synchrotie system to a more stable power supply or to provide reduced voltage starting for any large motors on the same line. Capacitors might also be used to advantage to stabilize the line voltage if the surges are local or if produced by the transmitter's driving motor.

Conversely a 10 per cent increase in voltage will result in a 21 per cent increase in pull-out torque. Application of voltage booster autotransformers in the line of a critical synchrotie system that appears overloaded may solve the problem.

Synchrotie units have inherently low power factor and where the installed capacity is large, addition of capacitors will be desirable for power factor correction as well as for better voltage stability.

Good mechanical maintenance is necessary because synchrotie driven machines can also drop out of step due to causes such as slack chains, loose coupling and gears, too severe a pulsating action from cams, pistons and cranks, the sudden binding or freezing of bearings and sudden overloads. By using an ammeter, the extent to which these mechanical deficiencies cause overloads in the synchrotie system can be readily observed.

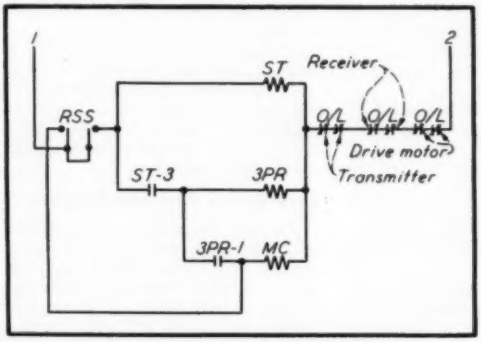


Fig. 3—Simple control for with-the-field operation applies single phase power first, then three phase power, to synchrotie units. Main drive motor of the system is energized last

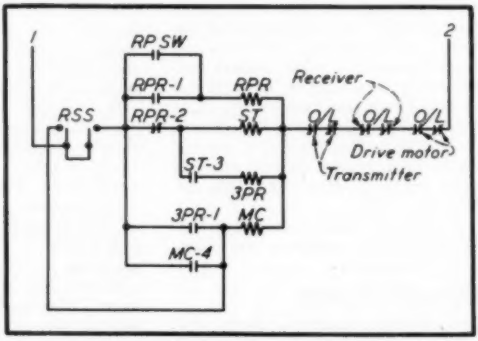


Fig. 4—For operation against the field rotation, an anti-plugging switch is included to deenergize the system and prevent reversal of receiver in case it pulls out of step

TABLE OF SYMBOLS USED IN FIGURES 2, 3 AND 4

Symbol	Description	Action
RPSW	Reversal protection switch	Closes at instant of reversal.
RPR	Reversal protection relay	De-energizes synchrotie on reversal at pull out.
ST	Synchrotie motor controller	Applies power to two of the stator leads of the synchrotie units, to bring them in step.
3PR	Third phase relay	Applies power to the remaining stator lead. (A slight delay in closing of this relay may be necessary for some installations.)
MC	Motor controller	Standard motor controller for drive motor.
O/L	Thermal overload trips	Sized for the individual continuous current rating of the elements involved.
RSS	3 pos. SPDT rotary selector switch	Manual control of operation.

What to do until the doctor comes

Emergency methods that may keep your equipment running after a breakdown until the permanent repairs are made

RETHREADING THREE PHASE MOTOR COILS

N. B. CLAPP, *Small Motor Division*
Westinghouse Electric Corporation

RETHREADING or replacing one or two shorted coils in a polyphase winding is practical providing care is used in the repair operation and in locating the shorted section.

For the coil type of winding, the first step after ascertaining location of the short is to heat the winding so that the wires can be moved without cracking or breaking the insulation. All connections to the defective coil should be opened before removal begins. As soon as the winding is pliable, the defective coil is cut out. Normal practice is to cut one end of the coil near the laminations and withdraw the individual wires one at a time.

If the space factor permits, a little additional working room can be obtained by "drifting" or prying the adjacent coils away from the one being removed. The wedge and wire must be taken out with considerable care to avoid damage to the slot insulation and adjacent coil covering. Addition of a piece of oiled silk or glass insulating material may be necessary to strengthen any weak place in the slot cell.

After the defective coil has been removed, the other windings in the affected slot should be moved toward the bottom so that the replacing coil will be on top of the other windings in the slot. In threading the new coil into the slot through the narrow opening, guide pieces of smooth insulating material can be used to prevent snagging the new wires on the edges of the steel punchings. Either a new coil or the proper number of the correct size wires (to replace individual strands) is threaded into the slots.

The repair destroys the symmetrical appearance of the winding, but operation of the motor is not materially affected. The replacing coil sides will be on top in both slots instead of on the bottom in one.

The new coil is connected to the rest of the winding in the same manner as the original. Impregnation with varnish by dipping or brushing and the normal baking period should follow. In replacing insulation, make certain that it is as good or better than the types used at the time of the original winding.

The number of coils that can be replaced practically by this method is determined, to a large degree, by skill of the workman, urgency of the repair operation and comparative costs between this type of repair and a normal rewinding operation.

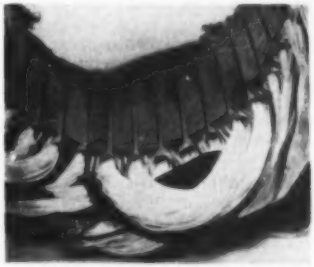
One limitation of this type of repair is that it is confined almost exclusively to coil windings. Skein windings, in which individual coils are not used but an entire group of poles of a given phase is composed of a single skein of wire prewound to a prescribed length, does not lend itself readily to this method of replacing coils. Although possible, an entire skein rather than a single coil must be replaced.

In an emergency, if the short can be definitely located and confined to a few strands, it may be possible to mark and cut those affected, replace them by new wires threaded through the slot and spliced to the cut ends of the original strands. The operation requires close attention to the marking of the two ends of the same strand on opposite sides of the slot.

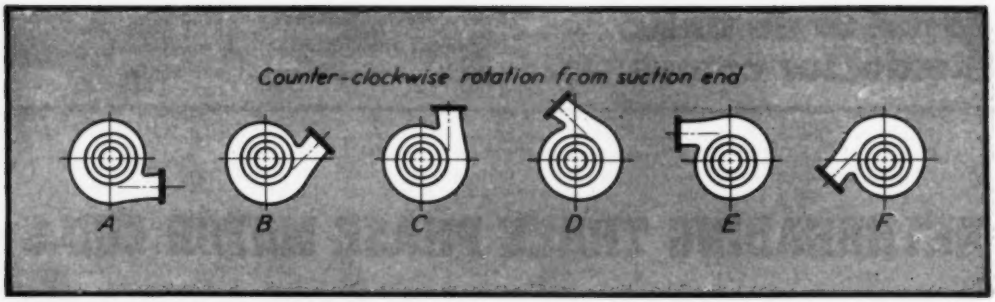
In extreme cases, where continued operation is absolutely essential, a single shorted coil can be disconnected, cut so there are no continuous loops, the cut ends insulated from each other and securely taped. This bypasses the defective coil completely. It is not a recommended procedure, but might save the situation until a permanent repair can be made when the motor can be removed from service.

In replacing shorted coils, warm stator, then cut one end of the coils near the laminations so that may be removed

After wires are pulled from the slot, remaining top windings are pressed to the bottom to make room for new coils



New coils are put in the top of the slots. The winding is not symmetrical, but motor will operate satisfactorily



Possible discharge locations for solid casing end-suction type centrifugal pump. Rotation of the impeller is determined by a position from the driven end of the pump. Diagram "A" would be designated bottom-horizontal discharge.

CENTRIFUGAL PUMPS . . . . . CASING DETAILS AND CONSTRUCTION

Part 2*—Nomenclature for pump casing styles is defined along with inlet and outlet designation. Emphasis is placed on flow to impeller eye and means of obtaining uniform flow through waterways

IGOR J. KARASSIK and ROY CARTER,
Application Engineers
Worthington Pump and Machinery Corporation

IN DISCUSSING centrifugal pumps, *solid casing* implies a design in which the waterways leading to the discharge are all contained in one casting or fabricated piece. In order that the impeller may be introduced into such a casing, the latter has to have at least one side open. As the sidewalls surrounding the impeller are in reality part of the casing, a solid casing, strictly speaking, cannot be used and designs normally called solid casing are really radially split designs.

By *split casing* is implied that the casing is made of two or more parts fastened together. The term *horizontally split* was devised to indicate the casing construction usually employed with horizontal shaft double suction pumps in which the casing was divided by a horizontal plane thru the shaft centerline or axis. That designation was an unfortunate choice as applications of the same design of pump for vertical use or with the discharge position rotated confused the terminology. Many design engineers now prefer the terminology *axially split* for this type of construction. As both the suction and discharge are normally in one half of the casing, this construction permits the removal of the other half (upper half in the case of horizontal shaft pumps) for examination of the interior without disturbing the bearings or the piping.

Like its counterpart *horizontally split, vertically split* is bad terminology. It is intended to refer to a casing split in a plane perpendicular to the axis of rotation. The term *radially split* is now being used by some designers to designate this type construction.

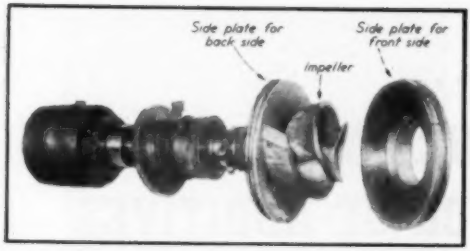
In some special applications of horizontal shaft pumps, it is desirable to use a casing split along a plane passing through the pump axis but inclined diagonally to the horizontal. This construction is used primarily in horizontal shaft pumps for which a vertical discharge is necessary and yet for which the convenience of an axially split casing for internal examination.

Most end suction single-stage pumps are made with one piece or so called solid casings. At least one side of the casing must be open so the impeller can be assembled in the pump, thus necessitating a cover for that side.

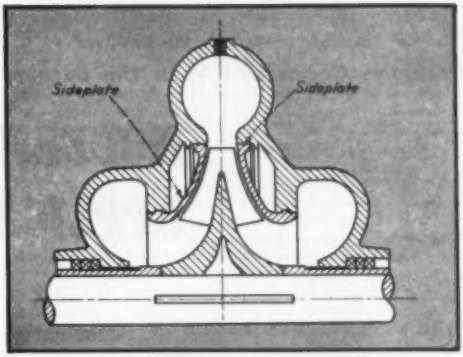
For general service, the end-suction single-stage pump design is extensively used for small pumps up to 4 and 5 in. discharge size, for the motor mounted type and for the cheaper "contractor" types. In all of these types, the small size makes feasible casting the volute and one side integrally. Choice of whether the stuffing box or suction side is made integrally with the casing is usually determined by the general design and obtaining the lowest possible cost. For larger types, especially those for special service like sewage pumps, there is a demand for both rotations and a design with both a separate suction head and a separate stuffing box head that permits utilizing the same casing for either rotation when the flanges on the two sides are made identical. Furthermore, for this latter group there is a demand for vertical shaft pumps, which can best be disassembled by removing the rotor and bearing assembly from the top of the casing. In many horizontal applications the installation favors partial dismantling from the suction side of the pump.

In the inexpensive type open-impeller pump, the impeller rotates within close clearance of the casing proper. When the service, for which the pump is intended, is more severe a side plate is mounted within the casing to provide a renewable close clearance guide

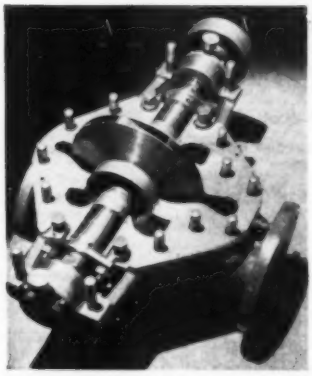
* This article will be included in a book on centrifugal pumps now being prepared by the authors: hence all rights to republication are reserved by them.



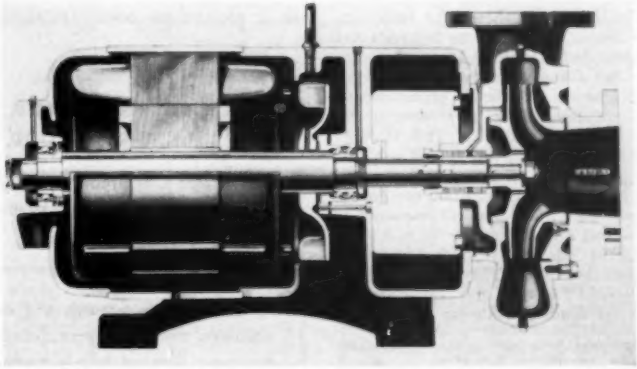
This rotor and casing, with side plate, handles abrasive materials in the paper pulp industry



Side plates are incorporated into a pump to provide removable close clearance fluid guides



Axially split casing for single-stage pump with side suction and discharge



Cross section of end-suction centrifugal pump arranged with removable suction head. Removal of suction head permits access to the impeller or replacement

to the water flowing through the open impeller. One of the advantages derived from incorporating sideplates is that abrasion resistant material, such as stainless steel may be utilized for the impeller and side plate while the casing may be made of a less costly material.

Under certain improper entrance conditions or when the shape of the suction approaches are incorrect the liquid column in the suction pipe may spiral for some distance ahead of the actual entrance into the impeller proper. This phenomenon is called *pre-rotation*, and may be occasioned by many factors. Also, it may exist in either vertical or horizontal types of centrifugal pumps.

Pre-rotation is usually harmful to proper centrifugal pump operation, because it causes the liquid to enter between the impeller vanes at an angle other than contemplated in the design. This results frequently in a lowering of the net effective suction head and the pump efficiency. Various means are used, either in the pump construction or in the design of the approaches, to avoid this phenomenon.

Practically all horizontal single-stage double-suction pumps and most multi-stage pumps are provided with a suction volute. The function of this is to guide the water in a streamline flow to the eye of the impeller. Flow coming to the eye is basically at right angles and partly to both sides of the shaft but not in equal proportions. The suction waterways reduce in area meeting in a projecting section of the side wall dividing the two sections. This projection is called a *stop piece*.

In end-suction type of pumps, improper entrance conditions may cause pre-rotation. To prevent this, a radial fin stop piece projecting partly in toward the center from the suction wall may be incorporated in the design of end-suction pumps.

Horizontal end-suction single-stage pump discharges are generally in a top vertical position, although other positions may be obtained in certain cases, such as top-horizontal, bottom-horizontal or bottom-vertical discharge. However, sometimes the pump frame, bearing bracket or baseplate will interfere with the discharge flange, prohibiting a bottom-horizontal or bottom-vertical discharge position. In certain other cases, solid casings cannot be rotated for various discharge positions because the seal connection on the stuffing box would be inaccessible.

Practically all double-suction axially (horizontally) split casing pumps have a side discharge and either a side or a bottom-suction inlet. When the suction is placed on the side of the pump casing, with its axial centerline at right angles to the vertical centerline, the pump is classified as a side-suction pump. When the suction points vertically downwards the pump is called a bottom-suction pump.

Special positions can sometimes be

(Continued on page 134)

Problems Concerned With the Burning of . . . .

MODERN FUEL OILS AND THE APPLICATION OF ADDITIVES

Data and information presented here are based on years of research aimed at elimination of sludges and deposits in pre-burner systems as well as elimination of slag and soot in boiler furnaces. Emphasis is placed on additives developed to overcome these problems

R. C. ULMER, *Technical Director*
R. W. WOOD, *Research Engineer*

Power Chemicals Division, E. F. Drew & Company, Inc.

• Considerable research and study have been applied to combustion problems during the past decade. In the case of oil fuels this effort has been directed largely toward the elimination of sludges and deposits in pre-burner systems and the elimination of slag and soot in furnaces of boilers. A survey of the literature shows little if any authoritative information on these subjects. The use of additives in oils is especially controversial and most of the articles dealing with it do little more than explain some of the problems. Little or no data are given.

Several years ago the writer and his associates conducted studies in this field in an effort to ascertain the fundamental causes of the above referred to difficulties in the burning of oil and especially to study the applicability of additives to the elimination of the problems. This article deals with some of the data obtained and especially the conclusions that were reached in the work.

THE TERM "fuel oil" has been or is being applied to a wide range of products for which combustibility appears to be the chief requisite. This results somewhat from the fact that in the last decade there have been considerable changes in the processes and methods for refining crude oil.

No. 6 fuel oil, the type with which this article is chiefly concerned, is essentially a left-over product in refinery operations (1). This accounts for the relatively low market value of No. 6 fuel oil. Owing to this situation a minimum of information concerning the chemical and physical properties of residual oil is available. In fact, even ASTM does not give much information regarding it, ASTM designation D-396-48 T giving only three specification limits as follows:

Flash point, F minimum	150
Water and sediment, % maximum	2
Viscosity, Furol 122 F maximum	300
Viscosity, Furol 122 F minimum	45

More specifically, fuel oil may be defined as a mixture of hydrocarbons having a volatility too low to permit its use as a motor fuel, except those grades that are suitable for diesel fuel. The type of hydrocarbons constituting fuel oil vary considerably, and the chemical and physical properties vary accordingly. Hydrocarbons occur in series containing many members the lightest of which are generally gases, the intermediate members liquids, and the heaviest ones solids. The hydrocarbons may be classified as belonging to (1), paraffin series, (2), olefin series, and (3), the acetylene series.

It may be stated generally that if a fuel consists wholly or largely of the paraffin type, the fuel will have chemical stability and will slightly retain its original properties. If the fuel contains a large or relatively large amount of the olefin and acetylene type materials, it will lack chemical stability and will tend to react with oxygen from the air to form gummy impurities, to change color and otherwise lose its original properties.

Other active chemical series of hydrocarbons of interest in fuel chem-

NO. 6 FUEL OIL VARIATION SAMPLES FROM FOUR MAJOR REFINERIES

	Refinery A, east coast	*Refinery B, east coast*	*Refinery C, middle west*	*Refinery D, southwest*	Range
Gravity: API	13.9 - 14.3	12.3 - 14.3	11.4 - 12.6	13.2 - 16.0	11.4 - 16.0
Viscosity, Furol 122 F	148.4 - 157.3	115.5 - 196.2	93.4 - 155.4	66.6 - 106.0	66.6 - 196.2
Flash point, F (PM)	+ 196 - + 250	+ 150 - + 285	+ 225 - + 255	+ 180 - + 250	+ 150 - + 285
Pour point, F	+ 5 - + 40	+ 20 - + 50	+ 10 - + 30	0 - + 20	0 - + 50
Sulphur, wt., %	2.89 - 3.39	2.53 - 3.61	0.75 - 0.89	0.83 - 1.19	0.75 - 3.61
Water and sediment, %	0.2 - 0.2	0.1 - 0.4	0.10 - 0.40	0.02 - 0.2	0.02 - 0.50
Carbon residue, %	11.72 - 13.09	10.2 - 12.99	10.0 - 12.1	7.26 - 8.93	7.27 - 13.7
Ash, weight, %	0.046 - 0.060	0.033 - 0.051	0.021 - 0.035	0.0048 - 0.086	0.0041 - 0.086
Total V_2O_5 of total ash	7.9 - 22.6	26.2 - 62.8	9.2 - 18.9	0.0 - 4.9	0.0 - 62.8
Total vanadium as V:PPM of oil	26 - 68	68 - 144	14 - 27	2 - 11	2 - 144

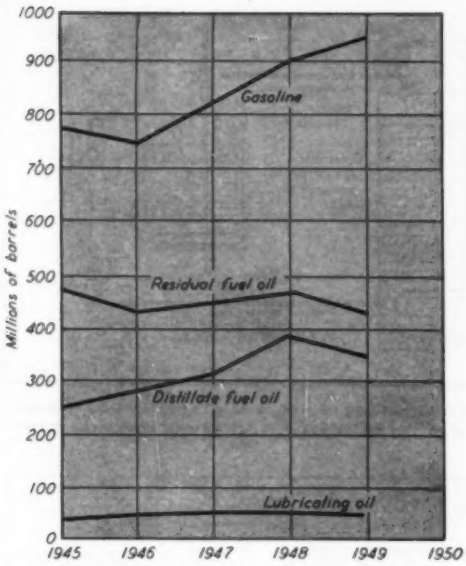


Fig. 1—Trend in production of U. S. petroleum products. Improvements in refining methods affect quantity and quality of fuel oils as discussed in the adjacent box

REFINING METHODS AFFECT FUEL OIL CHARACTERISTICS

● The following information on refining procedures is useful in predicting and studying problems involved in the combustion of fuel oils. Three methods of refining are now in general use, (1) straight run distillation, (2) thermal cracking and (3) catalytic cracking.

Straight run distillation is the oldest and simplest of the three basic methods. It is now considered obsolete and unprofitable. This method gives a relatively high yield of fuel oil and as the residual product has no cracked components, its stability and compatibility characteristics are good.

In the case of the thermal cracking method, the primary difference as compared with straight run distillation is the application of higher temperatures and pressures. As a result of the higher temperatures and pressures, thermal decomposition of the hydrocarbon molecules takes place and there is a higher proportion of gasoline and kerosene recovery. In general there is a fixed amount of ash, vanadium and some other components in the initial crude oil, which components tend to remain in the residual or fuel oil. Consequently, any refining method such as this that results in a higher yield of gasoline and other volatile products will give a fuel oil with a higher concentration of so-called objectionable components.

The catalytic cracking method also depends basically on the chemical decomposition of the hydrocarbon molecule by thermal cracking, but in this case a catalyst is used. The same general type of No. 6 fuel oil will be obtained by this process as by thermal cracking, the chief difference being that a large portion of the fuel oil will be uncracked residue from the atmospheric distillation still.

istry are the naphthenes and the aromatics. Although from the above it is evident that the types of products present in fuel oils vary greatly, the ultimate analyses — carbon, hydrogen and oxygen content — is remarkably uniform in the different fuel oils.

Since No. 6 fuel oil is primarily a by-product in refining and since refining methods have been altered greatly in the last decade, some consideration should be given to the various types of refining procedures as this information will be useful in predicting and studying problems involved in the combustion of fuel oils. These are described briefly in the box in the upper right-hand corner of this page.

Regardless of the refining methods used, it should be pointed out that chief efforts are directed in refining toward the production of more and better gasoline and lighter fractions. As mentioned above, this has had a pronounced effect on the type of residual oil or fuel oil left. Especially there are more so-called ash components present in the oil, and in many cases the oil must be considered less stable than previously. In addition, consideration must be given to stability and compatibility of mixtures of fuels from various sources of supply.

When fuels were produced predominantly by straight run distillation, this was not necessary as all of the constituents in the fuel were uncracked in nature. However, when thermal cracking takes place, the residual fuel oil will contain a multitude of hydrocarbons of widely varying characteristics. Therefore, the problem of stability and compatibility of oils becomes an item of greater concern.

As mentioned, such decomposition does not take place to the same degree in catalytic cracking and as more and more oil is being refined by this system it is possible that the quality of fuel oils will improve. Some idea of the relative amounts of oil produced in the period 1945 to 1950 are shown in Fig. (1).

In the paper by Kottcamp and Crockett (1), considerable emphasis is placed on the variation of the residual or fuel oil in relation to the source of the initial crude oil. Data were obtained on samples of No. 6 fuel oil taken weekly over an extended period from four major refineries. The variation at each of the four refineries together with the range of variation of all samples examined are shown in Table 1. Such data are valuable in considering the various combustion problems.

Still dealing with the basic procedures and methods for refining crude oil, considerable attention has been directed toward studies of the ash (2), (3). Most of these studies apply to attempts to eliminate ash deposits in the furnace and boiler proper. It is generally recognized that sulfur compounds in the ash may contribute to this problem but attention is generally centered on the vanadium compounds of the ash. The consensus of most metallurgists and chemists is that the vanadium pentoxide component of the ash is the compound of most concern in corrosion and deposits. Values for this component are given in Table 1 (1).

In an attempt to alter the amount and type of ash in fuel oil, centrifuging with and without water has been studied (1). Especially, attempts have been made to reduce the vanadium content by this process. Although centrifuging in general reduces the ash content appreciably, the vanadium content is not reduced accordingly.

There are various chemical procedures available for eliminating or reducing the vanadium content in oil but these are costly and are not generally applicable. The most practical approach for alleviating the effect of vanadium in the ash appears at present to be the use of additives in No. 6 fuel oil. This will be discussed later.

Experiments With Additives

In studying the application of additives to fuel oil combustion problems, attempts were first made to follow the results of various products in the field. However, it soon became obvious that storage conditions, oils and combustion of the oils vary to such a great

extent that it was difficult to draw any conclusions. Consequently, it was decided to set up laboratory experiments that would duplicate field conditions.

As sludge prevention was the chief subject of the investigation, most of the work was limited to the pre-burner part of the system. Two general types of equipment were used: first, that shown in Fig. 2 and which duplicates conditions at heat transfer surfaces such as found in heaters, and second, that shown in Fig. 3 which duplicates action in storage tanks and pipe lines where deposits of sludge may settle out or adhere (4).

In using the test equipment shown in Fig. 2, a constant volume of oil heated to a temperature around 165 F is circulated through a heater to which there was a constant heat input. Under this condition the final temperature of the circulating oil will depend on the cleanliness of the heaters; that is, the rate of heat transfer through the heater proper. Therefore, any variation in temperature of the oil leaving the heater can be taken as an indication of whether or not sludge deposition has taken place on the heater coil.

Fig. 4 shows a plot of a run with this equipment. Using untreated No. 6 fuel oil, it will be noted that for several days after the temperature in the system reaches operating conditions the temperature drops off, indicating that sludge deposition is taking place on the coils.

With a sludging oil, tests were conducted two ways: (1) sludge was allowed to build up on the coil and an additive then applied to determine whether the sludge could be removed, and (2) in some runs the additive was used at the start with a clean coil to determine whether the oil could be altered so that no sludge would form.

It will be noted that certain chemicals such as benzene, ortho-dichlorobenzene and many additives have little if any effect in either respect. One of the prime purposes of this work was, if possible, to develop an effective additive, and it will be noted that FOT-W, the final product developed was very effective in both respects. That is, when added after sludge had built up, after several days the temperature came back to normal indicating that the sludge was removed. On the other hand, if the additive FOT-W was added at the start of the run, little if any drop in temperature took place indicating that sludge was prevented on the coil.

The other equipment used, Fig. 3, makes it possible to study or determine whether sludge is present in oil and especially whether the sludge would be expected to come out of solution and deposit in strainers or in other parts of the system. Readings were taken of the pressure during the run. Any increase in pressure would be due to a build-up of sludge on the fine screen. Again the test could be carried out in two ways:

1. An untreated oil could be circulated in the system and, after pressure build-up owing to sludge formation a chemical or additive could be added to determine whether pressure could be restored to normal thus indicating solution of the sludge.

2. The additive could be applied to the oil at the beginning of the run to determine whether pressure build-up and sludge formation on the screen could be prevented.

Results of representative runs are shown in Fig. 5. Again it will be noted that chemicals such as benzene, ortho-dichlorobenzene and many additives have little if any effect on either type of run. However, the FOT-W is very effective in both types of tests. That is, as shown, once pressure has built up indicating sludge formation, addition of the FOT-W very quickly causes the pressure to come back to normal indicating that the sludge has dissolved. Also when the FOT-W is put into the circulating oil at the beginning of the run there is no build-up of pressure indicating that no sludge formation takes place on the screen.

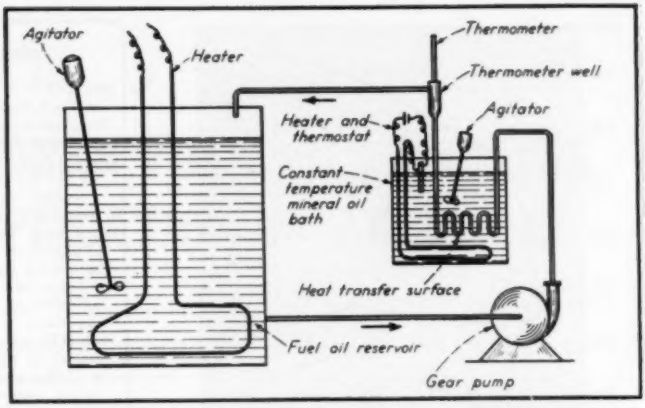


Fig. 2—Equipment used in studying the effect of sludging on heat transfer. A constant volume of oil heated to 165 F is circulated through the heater

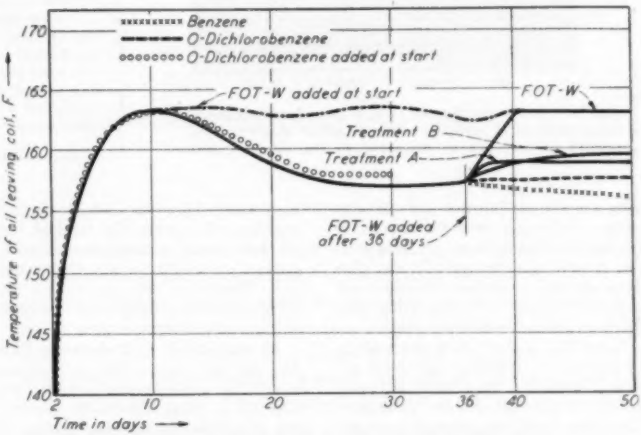


Fig. 4—Typical test results with heat transfer equipment. Temperature of untreated oil gradually drops off, indicating sludge deposits on the coils

Theoretical Aspects

A review of the rather meager literature (5), (6), (7), (8), (9) on the subject of sludging of fuel oils and a

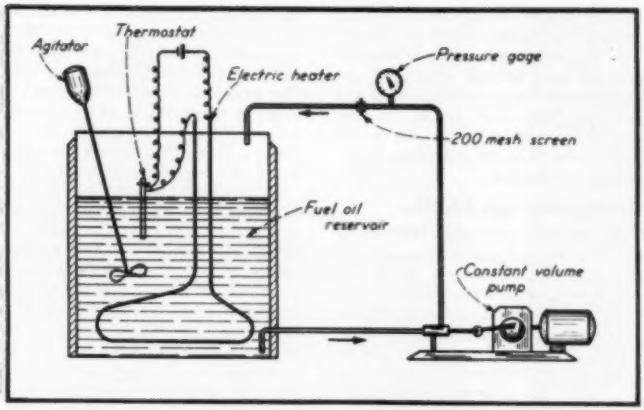


Fig. 3—This equipment checked presence of sludge in oil; also, if the sludge would come out of solution and deposit in parts of pre-burner system

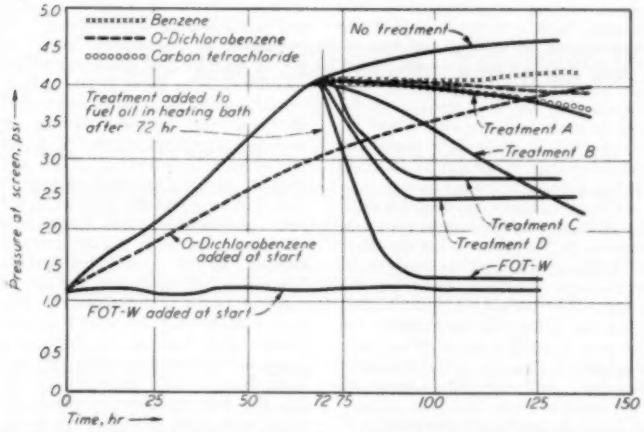


Fig. 5—Results of tests to determine sludging effect of oils. The use of additives indicates extent to which sludge formations can be dissolved

consideration of present day oil technology indicate that the usual concept of sludge in fuels oils is that materials come out of solution. The materials coming out of solution are generally referred to as high molecular weight products or "heavy residues." Investigation of sludge obtained from actual operating systems soon indicated that this was not the type of sludge generally encountered.

The type of sludge generally encountered is a water-in-oil emulsion. That such an emulsion will form very readily with heavy residue oil such as No. 6 oil can be indicated very readily by stirring about three parts of oil and one part of water very vigorously. The mixture stiffens and a "sludge" forms consisting of the whole mixture. Considerable sludge will form with far less than the above proportion of water.

Sludge is formed therefore in oil systems from emulsions formed by the small amount of water present in the system. The water may be present either as that not removed from the oil during the refining process or as that which leaks into the system or gets into the system by condensation.

Agitation of the oil and water by flow and pumping in the system causes the formation of the emulsion. As indicated in our laboratory tests, as well as in observations from the field, such an emulsion very readily settles out in tanks causing so called bottom sludge. It also deposits or settles out on heater coils, heater pipes and transfer surfaces greatly decreasing the rate of heat transfer and sometimes the rate of flow. A deposit also may form on lines and actually on the burner tips themselves. The latter may interfere greatly with atomization and therefore combustion of the oil.

It should not be inferred from the above that sludges are not formed in some cases from components coming out of solution in the oil. Such sludges consisting mostly of high molecular weight or heavy residue products may form also under high heat transfer conditions. When fuel oils from different sources or oils that have been catalytically cracked and uncracked ones are mixed there is danger of materials coming out of solution for the reasons mentioned in the early part of this article. However, in the authors' opinion, most sludge problems are due to the water-in-oil type emulsion.

Since sludge normally encountered consists of a water-in-oil emulsion, it is evident why some of the common solvents such as benzene and orthodichlorobenzene alone do not have an appreciable effect on the sludge. For example, in most cases addition of full strength chemicals to a small amount of sludge will have little if any effect; see Figs. 4 and 5. This is also noted in the case of many other additives.

On the basis of our research, attempts were made to modify some of the common solvents by mixing surface active materials with them to make them react rapidly with the water-in-oil emulsion. In addition to breaking the emulsion, that is separating the water, it was also thought that a desirable additive should hold 'normal" amounts of water in solution in the oil so that it would not separate out in the bottom of the tank. At the same time, of course, the additive should not contribute to corrosion in the system.

It goes without saying that the additive should not cause or increase difficulties from slag in the furnace and boiler proper. In fact, if anything the material should alleviate or eliminate problems of slag in the furnace and boiler.

All of these items were taken into consideration in developing the FOT-W product. Dosage of one pint per 1,000 gallons of oil is general. It is effective in (A) dissolving sludge in storage tanks and oil distribution lines, and dispersing it throughout the oil; (B) preventing formation of sludge in clean tanks and lines; (C) preventing sludge from clogging strainers and burners parts; preventing sludge formation in fuel-oil heaters; preventing carbonized sludge on burner tips, as well as in the furnace around the burner; and (D) preventing carbonized sludge from fouling injector noz-

zles, piston heads, valves and manifolds in diesel engines.

Soot and Carbon in the Furnace—Extravagant claims have been made regarding the benefits to be obtained through the use of additives in these respects. The authors' observations have indicated that there may be marked improvement in soot and carbon through improvement of combustion, but that this is about the limit of advantages to be expected. Through the use of fuel oil additives containing combustion catalysts, additional benefits are derived as indicated below.

Better Over-All Combustion—Through the improvements indicated above, there will be over-all improvement in combustion. This is due chiefly to better atomization or burning of the oil. These improvements lead to proper flame travel and generally increased combustion efficiency.

Cleaning Heaters

In addition to using the additive for elimination of sludge as indicated above, it has been applied successfully in two ways for cleaning heaters. (A) as a batch operation when the heater is out of service and (B), by injecting it into the fuel oil ahead of the heater for a period of approximately 8 hr during actual operation.

In batch cleaning of heaters, the general procedure is to drain the heater and remove as much of the fuel oil as possible. The heater is then filled with the additive and allowed to stand in this condition for six to eight hours. In general, through the vigorous solvent action on the water-and-oil emulsion, there will be sufficient agitation to completely clean the heater by this method. However, agitation will greatly decrease the length of time required to clean the heater or if a pump is available the solution can be circulated through the heater. In any case the heater can generally be cleaned more thoroughly than by mechanical means and at a reduced cost. In general also the time of outage will be less by chemical cleaning of this type than would be the case with mechanical cleaning.

The second means for cleaning heaters—injection of the FOT-W ahead of the heater— has been found quite successful in several plants. About four times the normal dosage, that is four pints per 1,000 gal of oil is injected into the fuel line ahead of the heater for about 8 hr. It is desirable to carry out this operation at low loads to make possible using as small amount of the additive as possible. It should also be done when the strainers may be cleaned more frequently than usual as this often is required. As indicated previously the additive may in some cases remove sludge so rapidly as to plug strainers until the system is cleaned out. By this procedure the heaters are restored to "normal operation" especially with respect to steam usage and pressures. The advantages of this procedure are obvious in that the heater need not be taken out of service nor operation interrupted.

Combustion Type Additive

As indicated previously, the authors maintain that there have been some extravagant claims made for certain additives with respect to their ability to improve combustion and especially to eliminate slag in furnaces and boilers. Also, as mentioned previously in the paper, it is the authors' opinion that in general regular additives will not have any marked effects along these lines. However, it is possible to include in the additive a combustion catalyst and if sufficient of the material is used, to obtain marked improvements in combustion. Such a material is FOT-CS. However, to get sufficient of the catalyst into the combustion chamber to effect slag and soot appreciably, it is necessary to use this material at the rate of about four pints per 1,000 gal of oil. This is about four times the normal dosage of the regular additive; that is, for sludge control only.

The combustion catalyst used is similar to those used in so called soot removers. In this respect it has the effect of lowering the ignition temperature of the soot or carbon. Therefore, the tendency is to burn up more of the soot. However, unless the temperature of the soot is sufficiently high to reach the ignition point it will not burn; therefore, such materials cannot be considered as a cure-all.

In certain improperly designed boilers or under certain operating conditions, soot will form even though such an additive is used. It should be pointed out that the FOT-CS exhibits sludge conditioning or sludge prevention properties as well as those of a combustion catalyst. That is, the one product can be used for both purposes.

Slag and Corrosion Prevention

As mentioned in the beginning of this article, certain types of fuel oils especially those containing large amounts of vanadium appear to contribute to slag and corrosion problems in furnaces and boilers. This subject has been discussed by Evans (2), Brasunas and Grant (3), and Kottcamp and Crockett (1). This subject is referred to in the present article only because as mentioned previously, extravagent claims are sometimes made regarding the effectiveness of certain additives in eliminating these difficulties. Assuming good combustion conditions, the authors are doubtful whether any of the so-called sludge preventing type additives have any marked effect on these difficulties. The only exception would be when the so-called slag might be due to improper combustion; for example, soot formation. In such a case a combustion catalyst type additive might improve conditions.

In the absence of good combustion, slag conditions may be very bad and in many cases additives may help tremendously, especially if the poor combustion is due to improper atomization of the oil. The subject of atomization of oil and its relation to slag has been considered by McCloskey (11). Briefly, liquid oil cannot burn and must be converted to vapor form as an aid in this process. The oil is atomized to increase its ratio of surface to mass. Vaporization of the oil is incomplete unless the droplets are very small. As pointed out previously, proper additives aid in the atomization process, and in minimizing slag problems.

Some data given by McCloskey are of interest. Good atomization produces an oil droplet of about 0.004 in. diam. Assuming an ash content in the oil of 0.07 per cent, the ash particles remaining after combustion will be of the order of 0.000002 in. diam. The ratio of surface to mass of such particles is infinity and the particles would have gas-like properties. They could be air borne perfectly and could not be thrown out of a deflected stream. Therefore they would not impinge on tubes or heat transfer surfaces. Also such molten particles would quickly radiate their heat on approaching a metal surface and thus solidify. In this form there is little tendency for adherence. Slag therefore is minimized when such small particles are present. Such small particles are insured by proper atomization of oil; therefore, use of a proper additive may help.

Referring more specifically to corrosion, many of the foreign oil fields produce oils high in vanadium; also, some of those produced in the United States are quite high in vanadium. Amgwerd (10) has carried out an investigation with a so called typical oil ash as follows:

OIL ASH RESIDUES

Compound	Percent
V_2O_5	66.6
Na_2	8.7
SO_3	12.8
Na_2O	5.2
Fe_2O_3	1.8
Al_2O_3	1.5
CaO	0.8
Remainder	1.3

It may be pointed out on the basis of the above references that there appears to be some alleviation and improvement in conditions of slag and cor-

(Continued on page 135)

Where fabrication of large and heavy walled pipe is involved, it pays to have stress relieving done in large ovens

Machining flanged joints on large curved pipe can be very difficult and great care must be exercised to do a good job

AN APPROACH TO PIPING DESIGN--2

After choosing the right material and determining pipe size from equations in the previous article, actual erection must follow these procedures to produce a trouble-free pipeline

ROBERT H. EMERICK, ***Consulting Mechanical Engineer***

PIPING'S HABIT of stretching when it's warm and shrinking when it's cold, insists on our indulgence by means of expansion bends, offsets, or expansion-compensating devices of one kind or another.

Sometimes we can reduce the effective movement of the pipe by installing it under "cold spring" stress. This means we can cut the lengths a little short and jack them together for making up the joints; then when the pipe grows warmer and longer, with its charge of moving fluids, some of the normal expansion goes into relieving the original stress.

If our jack is large enough, we can cold-spring a pipeline for one half of its expansion, but the code warns us not to count on more than one third, if we cherish safety in design.

The potency of small expansive moments is illustrated by a 14 in., 90 deg, built-up, welded, steel elbow that found itself in a tight corner between adjoining walls of the gas works. Only an inch of straight pipe cushioned the elbow from the crowding bricks, the position of the elbow being like that of a nut in a nut-cracker. In time the elbow split as a result of the conflicting strains.

Tables showing the expansion compensated for by a 90-deg bend for various radii and sizes of pipe may be obtained readily from handbooks, manufacturers' catalogues, and other concerned sources. For example, if we assume a minimum radius of five times the pipe diameter, we can expect a single 90-deg bend to care for ¼-in. expansion in 4-in. pipe, ⅜ in. in 6-in., ½ in. in 8-in., ⅝ in. in 10-in., ¾ in. in 12-in., and ⅞ in. in 14-in. pipe. Increasing the radius greatly increases the absorbing capacity of the bend; for example, 10 times the radius of a 4-in. pipe provides the cushion for a full inch of expansion.

As an alternative to piping bends, we might use a piston-type slip joint or bellows-like unit of copper corrugations to handle the expansion. Working pressures of the latter are limited by the code for steam service to 200 psig.

The fundamental law in designing for flexibility is to calculate the amount of movement accurately and safely. No device or method will safely compensate for a system that is underestimated or bound in any way. Proper estimating means to evaluate also any possible movement from the equipment to which the piping is attached.

Pipe Fabrication

More than one quarter of the Code for Pressure Piping is concerned with fabrication details, of which four-fifths is devoted to welding. Recently a public utility company was obliged to replace a system of high-temperature, high-pressure steam piping that served a new turbine-generator because the welded joints were showing progressive deterioration and leaks; a development that suggests the desirability of still more safeguards for welding procedures.

If we have important welding to do, a study of recommended practices as issued by the Travelers Indemnity Co. should be made as an essential preliminary. Its specifications are particularly valuable where field fabrication is concerned, and where temperatures exceed 750 F. Aspects covered in detail include (A) material and design, (B) qualification of welders, and (C) welding procedure and tests.

For shop welding, preheating equipment can be set up and arranged for optimum efficiency and top quality work. Preheating can be done in the field of course, using electric heatings, oil heaters and even gas torches; however, superior controls available in fab-

RECOMMENDED SOURCES OF DATA ON DESIGN AND FABRICATION OF PIPING

Association of American Railroads, 59 E. Van Buren St., Chicago.
American Gas Association, 420 Lexington Ave., New York.
American Petroleum Institute, 50 W. 50th St., New York.
American Standards Association, 29 W. 39th St., New York.
American Society for Testing Materials, 260 S. Broad, Phila.
American Water Works Association, 22 E. 40th St., New York.
Federal Specifications Executive Committee, Procurement Division, Treasury Department, Washington, D. C.
Manufacturers Standardization Society of the Valve and Fittings Industry, 420 Lexington Ave., New York.
Society of Automotive Engineers, Inc., 29 W. 39th St., New York.
American Society of Mechanical Engineers, 29 W. 39th St., New York, N. Y. (Issues the American Standard Code for Pressure Piping)
All specific publications mentioned by name in this article.
All local and state codes.
"Fabrication of Oxweld Piping," The Linde Air Products Co., The Union Carbide and Carbon Corp., New York.
"Compressed Air Data," Compressed Air Magazine, New York.
"Cameron Hydraulic Data," Ingersoll-Rand Co., 11 Broadway, New York.

All photographs courtesy of Benjamin F. Shaw Company

ricating shops have led most designers to prefer the latter program. Preheat temperatures may be expected to vary between 300 F and 600 F, the higher temperatures being appropriate when service temperatures also are high.

An important consideration in joint welding is the continuity of the weld metal deposit. If the joint has been preheated, and the progress of the welding is for any reason interrupted so the work shows some cooling, the original preheat should be restored before welding is resumed.

Stress relieving ovens offer another inducement for shop fabrication, particularly where large and heavy-walled pipe is involved. In the illustrated oven, the entire section of pipe can be heated uniformly to the 1100-1300 F required, and cooling can be controlled.

By contrast, stress relief in the field means the application to the pipe of an unwieldy two-section furnace lined with firebrick and fired with gas or oil. Since this sort of treatment is local, there is always the possibility of thermal strains being induced elsewhere in the line. In short, a great deal of care and supervision is essential.

Testing Welded Pipe

Welded pipe sections can be prepared for testing by sandblasting surfaces to remove scale and dirt. Generally, the section is filled with water, but sometimes with kerosene, and the pressure is built up to code requirements. We then watch for sweating and beads of moisture appearing on or around the weld, knowing that such manifestations mean porosity, pinholes, or hair-line cracks, conditions that must be corrected.

Whitewashing the pipe makes the detection of flaws much easier, especially if the testing fluid is kerosene. This distillate seems to ferret out the most minute and hidden passages that lead from the inner to the outer surfaces of the pipe.

An alternate way of using kerosene is to rub the exterior of the pipe thoroughly, let the liquid remain on the surface for a day or two, then wipe it off clean. Next, dust the surface with chalk or paint it with whitewash. If the kerosene has penetrated a fissure or pin hole, it will discolor the whitewash immediately above. With this procedure, however, the evidence does not prove the flaw to extend all the way through the metal, and it should not be used as a substitute for the standard hydraulic tests.

About Flanges

Commonly, the use of cast-iron screwed-on companion flanges is acceptable practice for pressures up to 250 psi. The 125 psi standard calls for a smooth face, the 250 psi for a 1/16 in. raised face. For the higher pressures and higher temperatures, we must go to either cast or forged steel.

Much of our trouble with flanged joints is the result of indifferent machining, unequal stresses from careless bolting, or a measure of both. One of the illustrations indicates why machining sometimes is of doubtful exactness—such jobs can be tough to handle. Obviously, uneven contacting faces mean uneven compression on the gasket, while unbalanced bolting tension affects both the gasket and the whole length of the joined pipes.

For instance, with Van Stone flanges, machining of the backs of the laps is sometimes overlooked, and as a result the flanges are cross-stressed, and we unjustly blame the design whereas the execution is to blame.

The use of seal welds with flanges is a common practice. As an example, the contacting laps of a Van Stone are chamfered around their outer circumference, and weld metal is run into the vee so formed. A similar procedure is characteristic of the Sarlun joint. Seal welding generally may be expected to produce a tight joint, but certainly defeats the basic purpose of the flanges, which is to provide a connection that may be disassembled readily at will. If we are going to use welding at all, we might as well go the whole distance and leave off the flanges entirely.

The "Marine Engineering Regulations and Material Specifications", as issued by the Coast Guard, has considerable to say about flanges and flanged joints. Where Van Stones are concerned, the ability of the fabricator to make an acceptable joint is bluntly questioned. The Coast Guard specifications demand that the flange be turned by machinery in one operation at a temperature of approximately 1700 F; furthermore, that the work be accomplished by trained operators. A fabricator must certify his ability to meet these requirements, or the Coast Guard will not have his Van Stones.

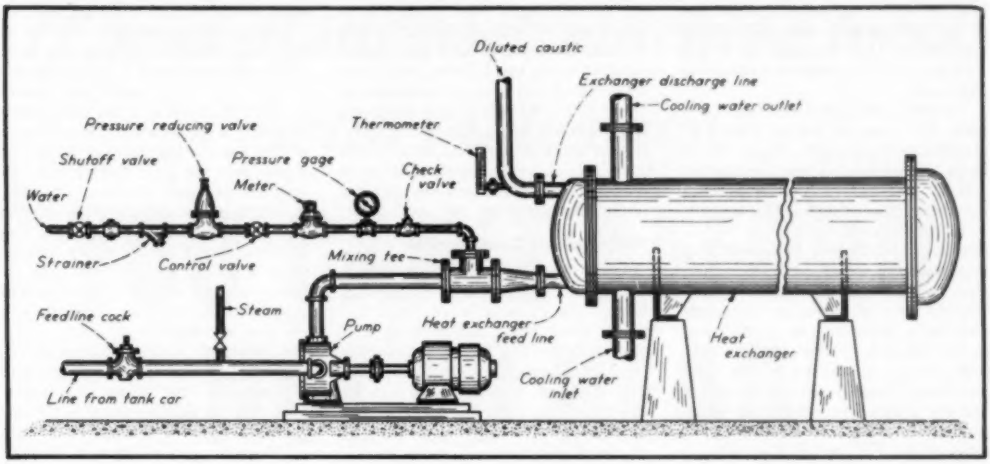
As a means to insure equal bolting strains in a joint, specifications sometimes require the use of strain gages on the wrenches when the nuts are being tightened. This procedure involves extra labor and time charges which the customer as a rule is asked to absorb. The Navy has carried out some tests on electrical tension indicators for small bolt sizes with definite success. Patents have been asked by the inventor and we can hope for its commercial availability before too long. The device is claimed to offer quite a saving over the strain gage procedure.

Correction — Credit of August Cover Illustration

The four-color cover illustration for our August issue shows a heat-treating furnace at the Lelance and Grosjean Manufacturing Company plant in Woodhaven, Long Island, N. Y. On page 84 of our August issue we incorrectly credited this installation to the Sunnyside Metals Products Company, Sunnyside, N. Y.

Materials for engineered plant services

Types and applications of materials that help to solve problems involving corrosion, abrasion, heat and pressure



Arrangement of equipment and pipelines for handling 73 per cent caustic soda

RECOMMENDED PRACTICES FOR HANDLING LIQUID CAUSTIC SODA

Different concentrations necessitate variations in unloading, handling and storing. Here are authoritative answers to the problems involved

R. A. SPRINGER, *Technical Services Division, Diamond Alkali Company*

LIQUID CAUSTIC SODA is manufactured and shipped by all major producers in two concentrations. These are identified as 50 and 73 per cent with the percentages representing the approximate sodium hydroxide content on a weight basis.

Although they differ only in their water to caustic ratios, their physical characteristics are quite different. Enthalpy, freezing point, and boiling point are a few of the important properties that must be carefully considered. These are different for each solution form, necessitating variations in methods of unloading, handling and storage.

Principal means of transporting liquid caustic soda is the tank car. A common practice is to ship it in either 8,000 or 10,000 gal quantities. Recently, however, smaller amounts of 50 per cent liquid are being transported by tank truck for use by industries located near the producers.

50 Per Cent Concentration

The 50 per cent caustic soda is used most commonly. Commercially, this strength may vary between 48 and 51 per cent. It has a freezing or solidifying point temperature range of 49 to 58 F. From an operational standpoint, it is practical to maintain solution temperatures considerably above this range. This is due to the high viscosity of 50 per cent liquor as the temperature approaches the freezing point. A recommended minimum temperature for a solution of this strength is 85 F. At this temperature the viscosity is no more than 25 to 30 cp. Then the caustic can be transferred by standard and inexpensively equipped pumps.

In order to transfer 50 per cent caustic by the most economical means, pipelines should be at least 2 in. diam. and 3 in. lines on suction side of pumps are recommended. A consideration of the resistance to flow in a pipe for 50 per cent liquor at 85 F will bear this out. At a flow-rate of 100 gpm the friction loss in head per 100 ft of 3 in. pipe is about 5 ft. Under the same conditions the loss in head for a 2 in. pipe is more than 35 ft. Because of frictional losses in pipelines, use of two 45 deg fittings is preferred to one 90 deg elbow. This is particularly important where a long suction line to a pump is involved.

Through experience, piping equipped

Abstract of paper presented by the author before the 1951 Annual Meeting of The Association of Pulp and Paper Industries.

with flanged connections has been found to be most practical. With flanges welded to the lengths of pipe and other fittings, and with alkali-resistant gaskets between the flanges, leaks will be held to a minimum. Maintenance labor costs are reduced because of the comparative ease with which replacements can be made. It is also a simple matter to remove sections for clean-outs.

To make drainage from lines complete after use, all piping should be installed with a slight slope. Avoid loops or pockets. These precautions will cut maintenance costs by preventing frozen lines during cold weather.

To control rates of flow and for line shutoffs, the standard lubricated plug cock has been found to be most suitable. It gives very economical service. Various types of valves are commonly employed, however, in caustic and caustic dilution systems; the less elaborate fittings appear to be the most satisfactory. Construction details should call for a sufficient number of steam connection fittings on all piping arrangements. This makes it possible to enforce the cardinal rule of steaming out all caustic lines both before and after use.

Either the open impeller centrifugal or rotary positive displacement pump may be used. Installation of either type of pump should include a bypass or circulating arrangement. This reduces wear on the pump and in many cases can be used as a means for controlling rate of flow. Location of a pump in a caustic soda system should receive careful consideration. For ease of operation the suction line must be as short as possible.

Storage facilities for 50 per cent liquid caustic soda must have capacity to accommodate a 10,000 gal shipment. Provision must be made for a reserve supply of caustic soda between shipments. Practically, it is suggested that total storage space be at least double the tank car capacity of 20,000 gal.

Extra heavy metal is preferred in the construction of caustic soda storage tanks. Specifications for fabrication should call for at least ⅜ in. wall thickness on the body of units larger than 10,000 gal capacity. The pipe connection for withdrawing the liquor from storage should be located a few inches above the bottom of the tank. A drain connection at the lowest point of the tank also should be included to facilitate flushing.

It is desirable to place 50 per cent liquid caustic soda storage tanks in a heated building that is maintained above 60 F. This will usually insure a storage temperature of 85 F or higher which is optimum for handling the liquor. Outside tanks must be supplied with a source of heat. A small coil or loop of 1 to 1¼ in. pipe connected to a source of low-pressure steam, 12 to 15 psi, is adequate. For the average mill, automatic controls on the steam are not warranted. Best practice is to warm the liquor intermittently as the occasion demands. With a temperature range of 85 to 140 F, little attention is required. Avoid storage temperatures above 140 F. Caustic soda is more corrosive to steel above this point. Insulation of tanks although desirable is not necessarily a requirement. The most economical thickness for common types of insulation is 2 in.

Materials of Construction

Usual materials of construction for a caustic soda system are steel and iron. Flange quality steel is preferred for tanks. Black iron, carbon steel, and cast iron are the best materials for pipes and fittings. Cast iron pumps work well although longer service can be expected from nickel or some of the nickel alloys. A very small amount of iron contamination will occur in systems of all-iron construction. If this is objectionable, nickel may be substituted. Nickel-clad steel, various alloys, and organic coatings are also used.

Dilution of 50 per cent liquid caustic soda to any desired concentration presents very few difficulties provided the method for handling the original 50 per cent liquor is mastered. Pumps, pipelines, tanks, and other equipment previously discussed are as least adequate for lower concentrations.

73 Per Cent Caustic

The second commercial form of liquid caustic soda is the 73 per cent liquor. Normally, this contains 71 to 73 per cent sodium hydroxide. At ordinary atmospheric temperatures it is a solid, for upon cooling, crystallization begins at about 45 F. Tank cars for 73 per cent liquid caustic soda are always fully insulated. It is the usual practice for producers to load at elevated temperatures so that the caustic will be received above 200 F.

The 73 per cent liquid caustic soda is seldom placed in storage at full strength by the consuming industries. It is accepted practice to dilute the 73 per cent liquor as it is pumped from the tank car. The concentration for storage varies according to what may be desirable; however, this is very frequently established as 50 per cent. The caustic system is then treated as a 50 per cent system from this point.

The additional equipment that is needed for a 73 per cent caustic soda system is (1) a mixing arrangement, and (2) a means of dissipating the heat of dilution. Dilution water is metered into a mixing tee where it is combined with a definite flow of the 73 per cent caustic soda. The solution that is formed passes though a water-cooled heat exchanger to remove the heat of dilution and thence to storage.

The pipeline from the tank car to the pump should be no less than 2 in. diam and preferably 3 in. diam. All 73 per cent caustic soda lines should be well insulated and for added convenience steam traced. The viscosity at 210 F is not high but cooling of the liquor near the pipe surface will appreciably increase resistance to flow. A length of more than 50 ft for the pump suction line is undesirable. The discharge line from the pump may be 2 in. diam. A properly designed dilution system will have a minimum piping distance between the pump and the heat exchanger.

Centrifugal pumps are used on occasion; however, a rotary, positive displacement type pump is advantageous for the dilution phase of the unloading-dilution operation. A capacity of 30 to 50 gpm will permit the tank car unloading and dilution operation to be accomplished during one 8 hr shift. At this rate a standard design heat exchanger can be used. The most simple dilution water feed arrangement is shown in the accompanying drawing. Proportioning and metering pumps for both the dilution water and the caustic soda have been used successfully but such apparatus increases the original capital investment.

In order to determine the size unit required, certain factors such as caustic pump delivery rate, cooling water temperature, and dilution concentration must first be established. For diluting 73 per cent liquid caustic soda to approximately 50 per cent at a rate of 40 to 50 gpm and with a maximum cooling water temperature of 70 F, an exchanger of 600 to 800 sq ft of cooling surface will serve the needs of most mills.

Cooling water requirements will not exceed 20 gpm. If the cooling water is 60 F, the volume may be reduced to under 150 gpm or an exchanger of smaller dimensions may be used. Water at 80 F would require as much as 50 gpm, or if preferable a unit with a larger cooling area can be substituted.

The materials of construction for both the 73 per cent and mixing sections of the system may be black iron, steel, or cast iron. Heavy-duty piping is essential. Certain alloys and nickel will give a much longer service than iron and steel. Unless a small amount of iron contamination is undesirable the extra expense encountered for the more resistant metals is questionable.

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Card index and productive maintenance guides give engineers the tools to operate an efficient plant to obtain maximum production from existing equipment

PLANNED OUTAGE AS A TOOL

Here are systematic preventive maintenance and equipment outage hints to increase the life of units and assure production levels required for rearmament. Careful analysis of plant problems and completeness of records is the first step towards effective maintenance

AMERICAN INDUSTRY is being put to the test with the double-barreled job of defense rearmament and production to meet unprecedented civilian needs. They ask the seemingly impossible—more production when capacity has already been reached.

Possibilities for expansion, that were present in 1940 when the nation began arming for the second world war, do not exist today. At the present time, employment is virtually at its peak, and with the armed services requiring additional thousands of young men and women, there are likely to be fewer people to man the industrial front. Without additional employees, plant expansion is meaningless. And, for an extra complicating factor, capital equipment is increasingly hard to obtain.

An effective productive maintenance program consists of (1) an adequate staff of trained maintenance men, (2) the tools needed to perform the functions of regular, routine checks of operating equipment, (3) planned equipment outage at regular scheduled intervals. Rebuilding and modernizing machines during time of planned outage, and (4) an adequate stock of mechanical and electrical spare parts.

Important as the preventive activities are, they are capable only of preventing machines from doing less than they usually do. But the aim of productive maintenance is added production, surpassing the limits of output that are already achieved. This means having machines on line longer. Since they already are scheduled for use to the fullest, extra output can be gained only by minimizing their normal time-out from scheduled use for major repairs and overhauling.

Here is the heart of the productive maintenance idea—to overcome as far as possible unscheduled breakdowns of equipment causing delays in production. By providing for a system of planned outages—planned in advance for the time when the machines can be taken out of service for the shortest possible time—the stoppage will least affect total output and other operating units in the plant.

Planned outage is designed to replace, as far as possible, the unscheduled breakdown by taking the machine briefly out of service for a thorough, time-and production-saving repair job before it reaches the break down point. To do this effectively, a complete, systematic survey is conducted of the plant to see how it operates, type the equipment, and correlate the role each machine plays in relation to the others. Broad in scope, the survey thus analyzes first of all, the entire operation of the plant. It then determines the equipment that is most critical and carries the heaviest loads. It goes on to list machines and units in the order of their vulnerability, noting the condition of each — its age, state of repair, severity of duty and similar factors that will enter into determining the desirability of additional repair and the kind of maintenance required. On the basis of this survey, recommendations can be made for a sound, over-all planned-outage program, and the means can be devised for handling it with the minimum of interruptions to the normal production schedule.

Since productive maintenance is a long-range, continuing program, not everything can be done at one time. The program is realistic and economical in operation, designed to tackle first things first. Even if the plant had the resources to repair each machine at once, it would be self-defeating in stopping production altogether.

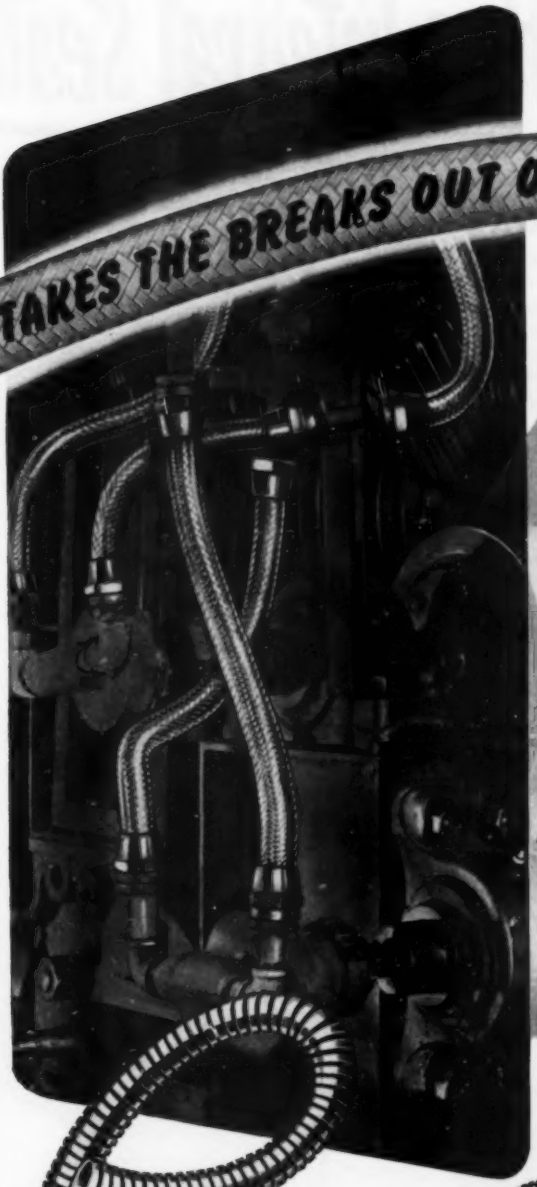
Equipment survey in the productive maintenance program serves to remove the guesswork from maintenance. Because of the total picture that it gives, other important improvements can be made at the time of the planned stoppage, improvements that might have necessitated stoppages of their own were they allowed to wait unattended.

The need for increased production throughout industry is great — and setting up a far-reaching productive maintenance program to achieve that added output should not wait. Recognizing this, the General Electric Co. has taken active steps to help maintenance men make management aware of the true value of productive maintenance. It provides maintenance men with a kit of tools, a series of aids that give the facts and guidance needed to carry out a productive maintenance program and to convince management of the necessity for industrial mobilization.

The kit contains an instruction bulletin, a typical balance sheet for keeping historical data on each machine, planned outage forms, and check-up lists for motors, control and other equipment. To further aid maintenance engineers establish productive maintenance programs, G-E service engineers, upon request, will assist in making a complete equipment survey to determine existing conditions, future outages, and to guide in setting-up a working spare parts control.

Productive maintenance is for all industry, whether a metalworking plant, paper mill, refinery, steel mill, rubber plant, or chemical plant.

TAKES THE BREAKS OUT OF SHAKES!



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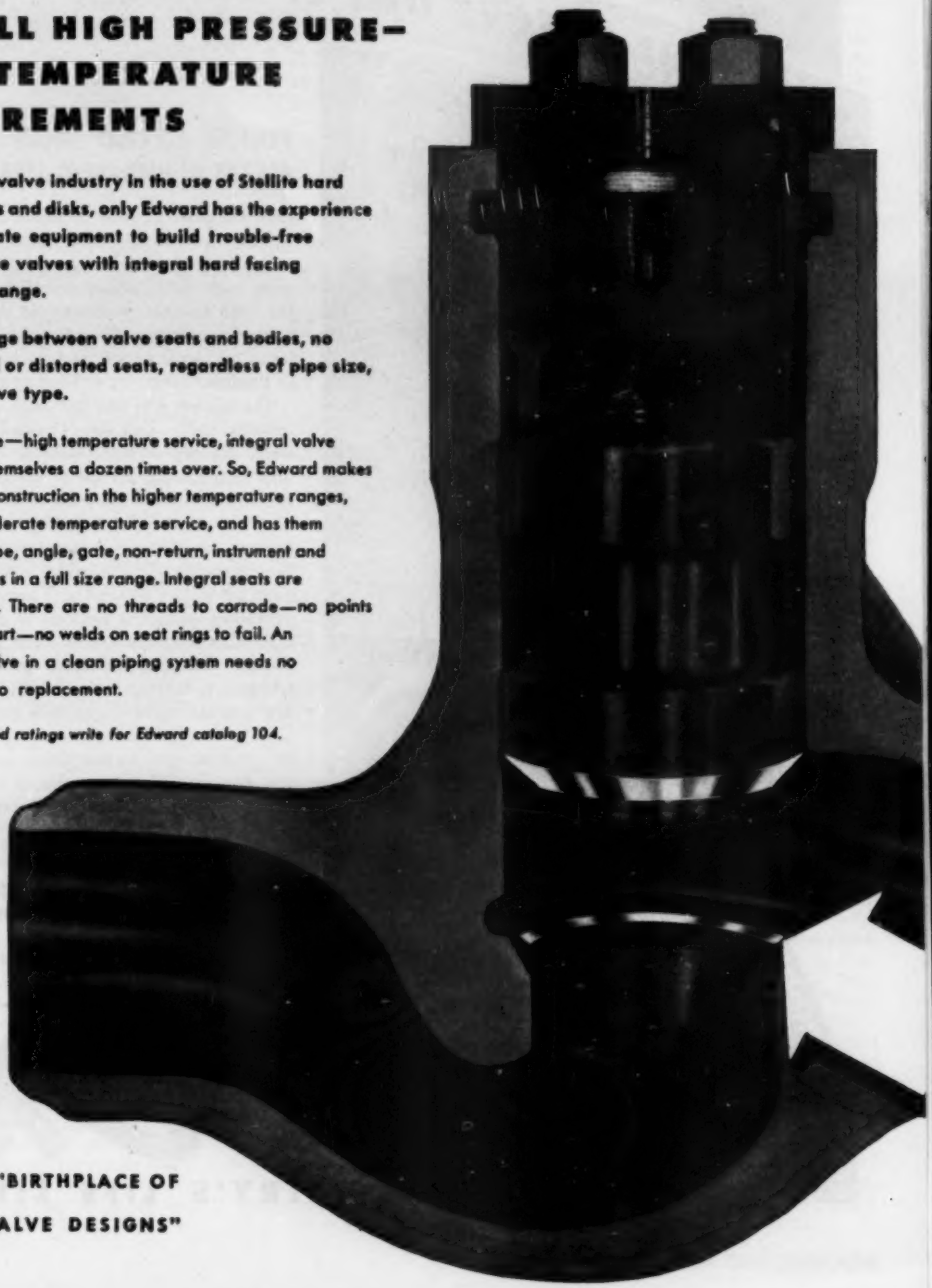

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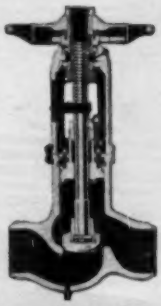

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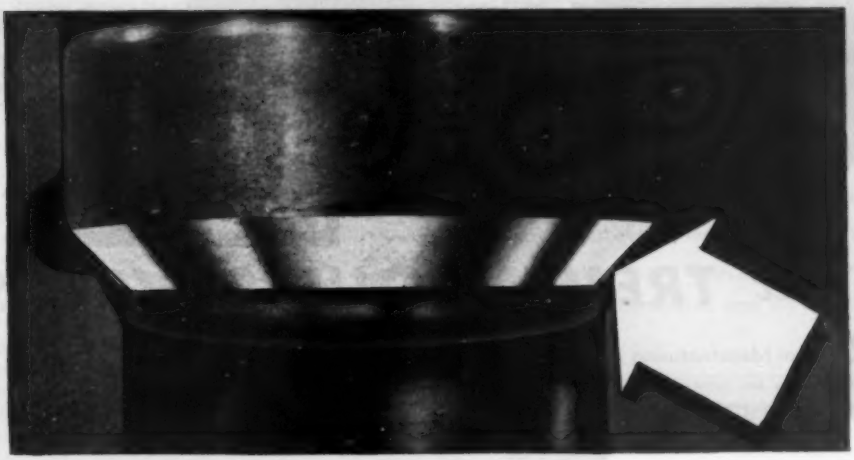

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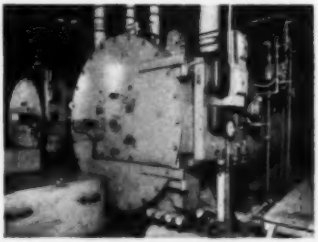

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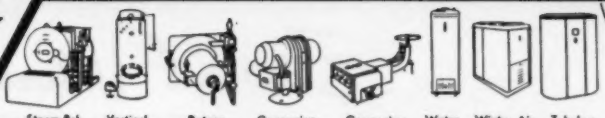
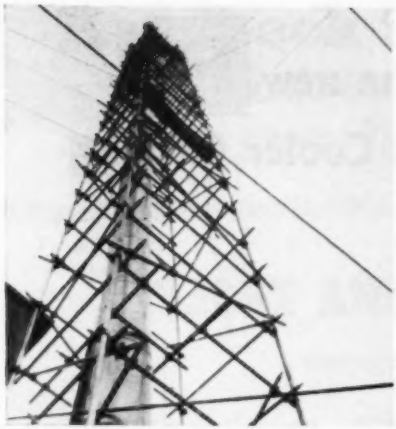
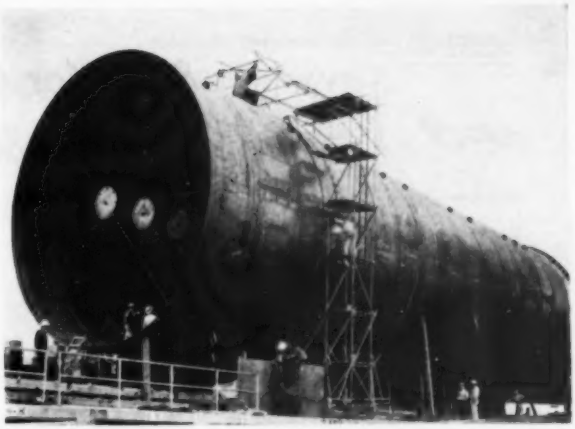




Looking skyward through the steel tubes that comprise the scaffold as maintenance men paint stack



Steel scaffolding can be erected around corners, such as this tunnel. When weld is completed assembly can be rolled to next operation point

STEEL SCAFFOLDING...A MAINTENANCE AID

Steel scaffolding is a perfect aid for maintenance, both inside and outside the plant. Erection and dismantling is simple and easy, and the four parts of which they are composed can be quickly stored

AT FIRST, there seems to be little in common between a tuck-pointing job and the erection of a temporary building or between smoke stack repairs and the quick assembly of heavy-duty storage racks. Yet, plant officials in many industries are finding that the factor common to all is the use of tubular steel scaffolding.

In a sense, *scaffolding* is a misnomer or, at least, an inadequate description. The reference is perfect for maintenance work, because it is a recognized aid in that operation. But, in other applications scaffolding becomes a structural material. Significantly, new uses are being found as characteristics and potentialities are more widely recognized for multi-purpose plant equipment.

In most industries, maintenance is limited by the variety of equipment available for off-the-ground work. Not infrequently ladders are impractical. Furthermore, suspended swinging scaffolds cannot always be employed. Wooden scaffolds are usually costly in materials and erection time.

Utilization of tubular steel scaffolding is a practical and low-cost answer to this recurring problem. With this equipment many industrial organizations do a variety of maintenance that previously was beyond the capacity of their equipment. Job reports on tubular steel scaffolding are highly favorable—especially on the points of worker productivity, safety and adaptability to job needs.

Simplicity of this equipment appeals to efficiency-minded maintenance men. There are only four basic parts — 2 in. steel tubes in varying lengths, two types of couplers and bases. Structures of any size, shape or contour can be quickly and easily erected — and dismantled just as fast.

Tubular steel scaffolding erections can be made indoors or outdoors on smooth, even floors or rough ground. Experience with this equipment shows there is enough flexibility for adaptation to almost any conditions encountered.

Tubular steel scaffolding is not a panacea for all off-the-ground maintenance problems, but it does offer many advantages. Industrial maintenance officials can very logically make a comparison between their job specifications and the capacity of tubular steel scaffold to meet them.

TABLE I—STATISTICS ON STEEL SCAFFOLDING

1. Initial cost is moderate. A limited stock of individual parts will take care of a variety of jobs.
2. Erection and dismantling are simple and rapid. This assures the minimum of labor costs. Only tools required is a ratchet wrench for adjusting couplers.
3. Tubular steel scaffolds provide safe footing for workers at any height.
4. Adaptable to any condition met in the average plant.
5. They do not obstruct light, air or vision and can be erected over and around machines and plant equipment without interruption to production.
6. Parts are 100 per cent recoverable and can be reused.
7. Tubular steel, the strongest scaffold material, is entirely fire-safe.
8. Scaffolds can be erected by unskilled labor with the minimum of supervision.
9. Appearance is neat, modern and entirely satisfactory regardless of the surroundings.
10. Addition of casters converts assemblies into practical rolling towers or work stands when desirable.

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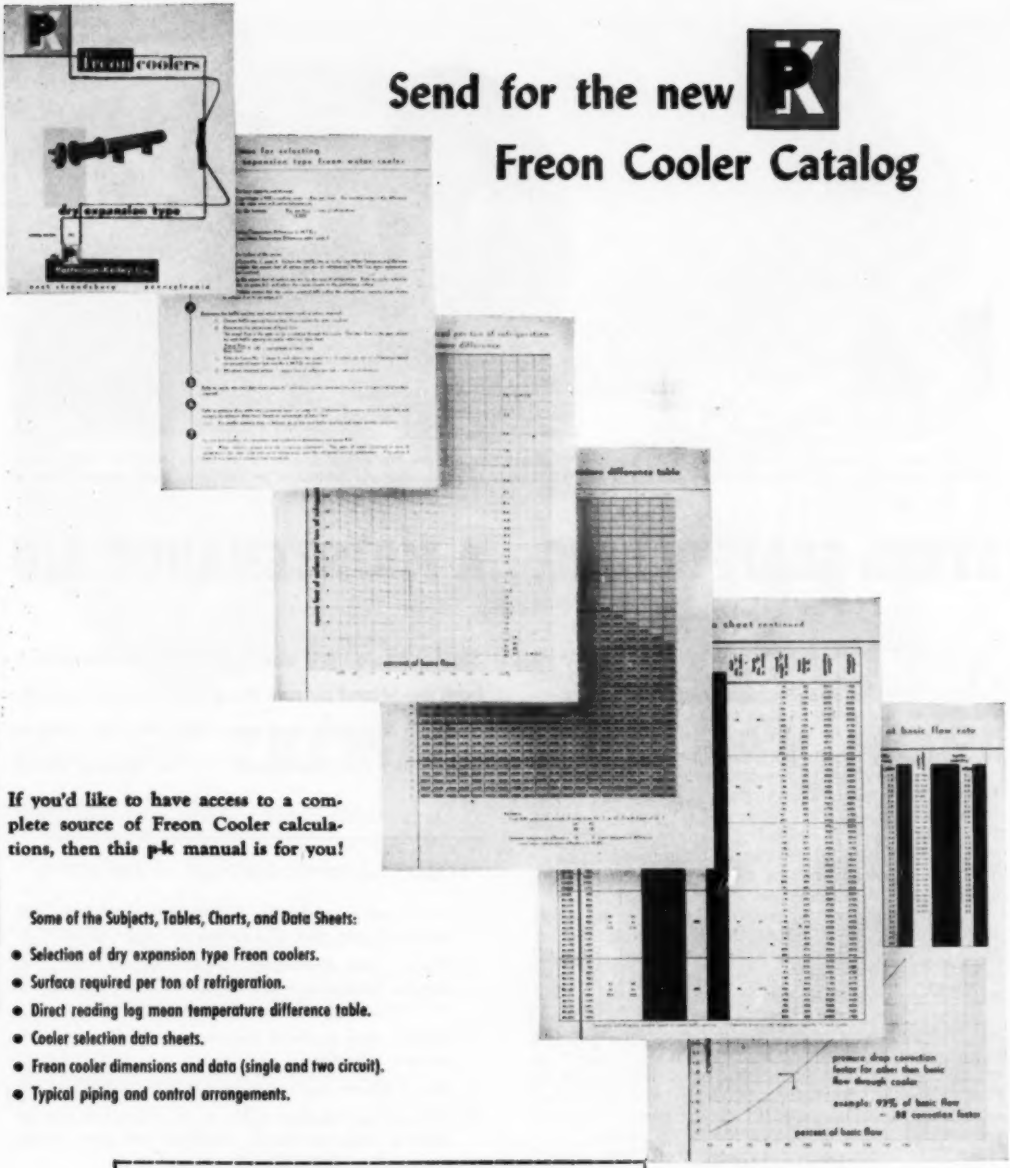

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FLIGHT AND APRON CONVEYERS

WILBUR G. HUDSON, *Consulting Engineer*

FOR CONVEYING bulk materials along a horizontal or inclined path, there are available the belt conveyer*, screw conveyer**, pneumatic and continuous flow conveyers, as well as flight and apron conveyers.

Flight conveyers *push* the material along troughs, usually made of steel plate. Therefore, coefficients of friction for various materials against steel should be known to determine the power requirement. Such coefficients are listed in Table 1.

Obviously, if the friction coefficient is very high, such as for wet sand, the flight conveyer is not advisable. While the coefficient for flights against the trough is 0.33, it is reduced to 0.1 if the flight is carried clear of the trough by rollers.

The conveyer may be inclined upward to where the material will cascade backward over the flights, usually 40 deg, which slope is too steep for a belt conveyer or screw conveyer. However, the latter will function with narrow-pitch helix.

Apron conveyers *carry* the material and so function without trough-plate drag. There is, however, some drag against the side plates which holds the material on the apron; values for such drag are given in Table 2. Skirt board drag may be disregarded in short feeders when estimating the power requirement.

The conveyer does not require a separate feeder since the load on the apron dams the inflow of excess material; in fact, this feature makes the conveyer available for feeding to another unit, as from beneath a track

*See INDUSTRY AND POWER, November, 1950, page 103; January, 1951, page 119.

**See INDUSTRY AND POWER, June, 1950, page 113.

Handbook data on pneumatic and continuous flow conveyers will be published in subsequent issues.

TABLE 1—FRICTION COEFFICIENTS AGAINST STEEL PLATES

Anthracite coal	0.33	Hydrated lime	0.65
Bituminous coal	0.59	Magnesium chloride	0.70
Cement	0.93	Pulverized limestone	0.58
Clay	0.60—	Sand and damp ashes	0.68
Coke	0.36	Sand, wet	0.95
Copra (varies)	0.40	Sawdust, wet	0.60
Corn, shelled	0.32	Soda ash	0.65
Grains	0.30—	Starch	0.78
Ground cork	0.65	Sugar, fine, pulv.	0.67
Hog fuel (dry)	0.68	Wood chips	0.35

Coefficient for steel or malleable iron flights usually taken as 0.33

TABLE 2—DRAG OF MATERIAL AGAINST SIDE PLATES

	Depth of load on apron, in.				
	12	15	18	24	30
Drag, lb per ft of length:					
Anthracite coal	6	9	13	22	35
Bituminous coal	6	9	13	22	35
Coke	3	5	7	12	20
Lime, hydrated	8	12	20	30	40
Limestone, pulverized	8	12	20	30	40
Wood chips	3	4	6	8	10
Lumpy ores and rock	—	—	20	35	45

TABLE 3—CAPACITY AND SIZE OF LUMPS HANDLED BY FLIGHT CONVEYERS

Flight width and depth, in.	Amount of material per ft of conveyer, cu ft	Capacity for 50 lb material at 100 fpm,* tons per hr (approx.)	Lump size**, in.	
			Single strand	Double strand
12 x 6	0.48	68	3.5	4
15 x 6	0.49	73	4.5	5
18 x 6	0.56	84	5.0	6
24 x 8	1.16	174	—	10
30 x 10	1.60	240	—	14
36 x 12	2.40	360	—	16

*If the conveyer is inclined, multiply the horizontal capacity by 0.90 for 20-25 deg; by 0.80 for 25-29 deg; and by 0.70 for 30 deg.

**Lumps not to exceed 10 per cent of total volume.

TABLE 4—CAPACITIES OF HORIZONTAL APRON CONVEYERS AND FEEDERS AT 20 FPM
(For material weighing 50 lb per cu ft and size of lumps permissible)

Width of apron between skirts, in.	Depth of material on apron, in.	Capacity at 20 fpm, tons per hr	Lump size*, in.	
			Avg.	Max.
24	12	45	4	6
30	12	56	6	8
30	15	70	6	10
36	12	68	8	12
36	18	102	8	14
42	12	79	8	14
42	24	158	10	18
48	12	90	8	18
48	24	180	12	24
60	12	113	12	18
60	24	225	15	28

*Large percentage of lumps assumed.

(Continued from page 109)

FLIGHT AND APRON CONVEYERS

hopper. As with the flight conveyer, the limit of inclination is reached when the material begins to slough backward; that is, between 30 and 35 deg.

Both flight and apron conveyers have limitations as regards maximum size of lumps. Limits for the flight conveyer are listed in Table 3. For the apron conveyer, corresponding data are given in Table 4.

Selection Factors

Where the capacity and length are large, the belt conveyer has the advantage in that the power requirement is much less than for the flight conveyer, and the first cost much lower than for the apron conveyer. In fact, first cost limits the desirability of the apron conveyer to short centers, as for feeders, or to wide, very slow speed installations such as picking tables. For moderate capacities and length, a type of flight conveyer should fit in nicely.

For small capacities and lengths, the flight conveyer has the advantages of ruggedness and low cost, equalled only by the screw conveyer, with the latter having the excellent features of compactness and ease of sealing by a cover plate—often a deciding factor.

For light non-abrasive materials such as wood chips and grains, a wood plank trough (maple is excellent) is sometimes preferred to steel. It takes a high polish and stands up well.

With the suspended flight conveyer, the friction coefficient of the shoes against guides may be reduced from 0.33 to 0.20 by a drip type lubricator.

The heavy drag of cement may be reduced by a few air jets (4 to 6 oz pressure) along the trough to aerate or fluidize the otherwise sluggish mass.

If an inclined conveyer will reverse under load, a back-stop or automatic brake is required. This is essential with long strands of rivetless chain which shorten when the tension is removed and snap out when power is again applied, subjecting the chain to many times its normal tension.

Apron feeders fed by a grab bucket with heavy lumps, such as rock and ores, should have apron sections of manganese steel which hardens under impact. Longitudinal T-rails should clear the underside of the apron by a fraction of an inch to relieve the shock on the roller chains.

Power Determinations

For a horizontal flight conveyer, the chain pull is

$$C = (2 \times W \times L \times F) + (W_1 \times L \times F_1)$$

Where C = chain pull or resistance to turning at the radius of the head sprocket, lb.
W = weight per ft of the sliding parts of the conveyer.
L = conveyer length between centers, ft.
F = friction coefficient of sliding parts of conveyer.
W_1 = weight of material, or load per ft of conveyer, lb.
F_1 = friction coefficient between material and trough.

When the flights are carried clear of the trough, use rolling friction (0.1) instead of sliding friction (0.33).

When the conveyer is inclined, there is a difference between the chain pull and resistance to turning at the radius of the head sprocket, since the downhill pull of the chain on the return run reduces the turning effort and power, but does not reduce the pull.

The turning effort for a conveyer inclined Y degrees is

$$(W \times L) \times [(\cos Y \times F) + \sin Y] + (W_1 \times L) \times [(\cos Y \times F_1) + \sin Y] + (W \times L) \times [(\cos Y \times F) - \sin Y]$$

The chain pull is the pull required for the equivalent horizontal path plus that required for the lift. The third item above will be a minus quantity when the return run is assisting the turning effort.

Similarly, for a horizontal apron conveyer the chain pull, expressed in pounds, is

$$C = RF \times (2W_2 + W_3 \times L) + D$$

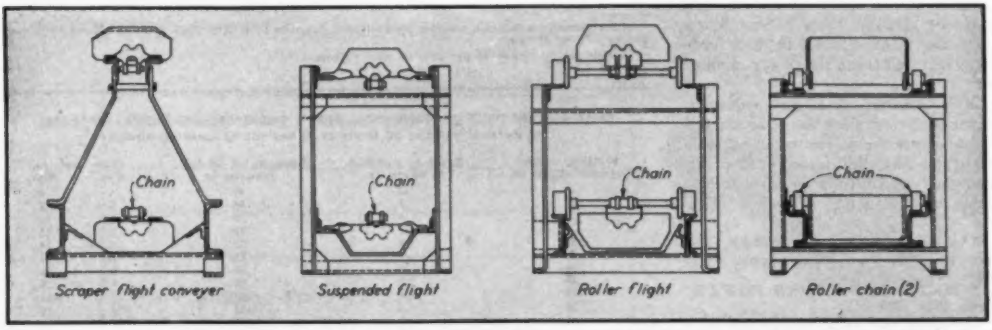
Where W_2 = weight of one run of the element, lb.
W_3 = weight of apron material, lb per ft.
L = distance beteen centers, ft.
D = skirt board drag multiplied by length in ft between centers.
RF = rolling friction = 0.1.

If the conveyer is inclined upward, add for the lift as with the flight conveyer.

From the chain pull we can determine the power requirement. First, to the pull or turning effort, we add 10 per cent for loss in the speed-reducing gearing and 10 per cent for friction loss. Calling this the gross turning effort, the motor horsepower is

$$hp = \frac{\text{Gross turning effort} \times \text{speed in fpm}}{33{,}000}$$

The chain pull derived from the above is the total chain pull. When there are twin chains, each has half that pull.



Various types of flight conveyors. Article gives formulas for horsepower calculations and data on service applications

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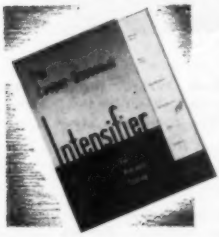


THE Cooper-Bessemer intensifier offers new advantages, new economies, wherever pressure testing is desired . . . for boilers, piping, compressor cylinders, pumps, all kinds of pressure vessels and laboratory destruction tests.

Completely air driven, the new intensifier eliminates fire and explosion hazards of motor-driven equipment, and easily develops hydrostatic pressures up to 23,000 psi using air at 90 lbs.

The extreme compactness and portability of the unit is another obvious advantage. It weighs less than 80 pounds, rolls easily to any job or location. Its completeness, versatility and low purchase price will also appeal to you . . . will save you still more dollars!

The intensifier is available in two sizes,—Model 10 for testing with water up to 10,000 psi and Model 23 for testing with oil up to 23,000 psi. For complete information send to any Cooper-Bessemer office for a new bulletin.

The **Cooper-Bessemer** *Corporation*

MOUNT VERNON, OHIO — GROVE CITY, PENNA.

New York City Washington, D. C. Bradford, Pa. Chicago, Ill.
San Francisco, Calif. Houston, Dallas, Greggton, Pampa and Odessa, Texas
Seattle, Wash. Tulsa, Okla. Shreveport, La. St. Louis, Mo. Los Angeles, Calif.
Caracas, Venezuela Gloucester, Mass. Calmes Engineering Co., New Orleans, La.

Spot news

Short, "boiled-down" paragraphs on the most interesting recent events and developments in American industrial plants.

Fairless Steel Works to Install Precipitators at Blast Furnace and Coke Ovens

Research Corp. has been awarded contracts by Wilputte Coke Oven Div., Allied Chemical and Dye Corp. and Arthur G. McKee & Company of Cleveland to cover installation of eight electrostatic precipitators at the Fairless Works. Each of the two new blast furnaces will have two Cottrell precipitators for cleaning up to 165,000 cfm of blast furnace gas.

The other four precipitators will be used to remove tar and oil from coke oven gas. Two will have capacities of 6,800 cfm and two will be rated at 25,000 cfm, 90 to 120 F, with a guaranteed removal efficiency of 95 per cent.

Steel Producers Seeking More Scrap From Industry To Keep Production Up

The high rate of steel production had steel companies scraping the bottom of their stock piles of scrap in midsummer when normally they begin to increase their inventories for the winter months. More scrap was needed than ever before if the production levels were to be maintained and increased. The period of greatest steel production required some 12 to 13 million net tons of purchased scrap in the first half of 1951, a high record amount.

Consumers' inventories of scrap fell about 30 per cent in the first half of this year. Supplies at some steel plants declined to only a few days' reserves and have shown little tendency to recover. Last year, iron and steelmaking furnaces in the United States consumed a record 53.7 million tons of scrap, nearly 14 per cent more than in the previous record year, 1948.

Iron and steel plants themselves, in the course of operations, produced about 58 per cent of the scrap they consumed, but more than 22 million tons were purchased from outside sources. Industrial and agricultural consumers of iron and steel products and machinery and equipment are being asked to collect unused, broken or obsolete items and sell them to scrap dealers.

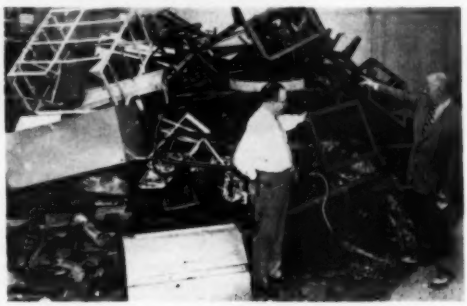
Typical of industry's effort to comply with steel producers' urgent request for scrap is the "Get in the Scrap Drive Week" program recently conducted by Lyon Metal Products, Inc., Aurora, Ill.

Lyon employees were asked to cooperate in the scrap drive by searching their homes, or asking their friends to help in collecting old and discarded scrap steel and iron. Lyon made arrangements with the Aurora Iron & Metal Co. whereby workers and trucks were provided to pick up and haul away all collected scrap.

Lyon, too, was in the drive as a company. Every effort was made in and around the plant to collect all types of steel and iron scrap to add to the drive. This was in addition to the regular production scrap constantly returned to the mills.

First Use of Magnetic Amplifiers on Winder Drive

The first application of magnetic amplifiers to the control of a large high-speed winder drive is being made by Westinghouse Electric Corp. They will perform control func-



Above: Supervisor from Aurora, Ill. plant of Lyon Metal Products, Inc. shows dealer partial collection resulting from company's scrap drive

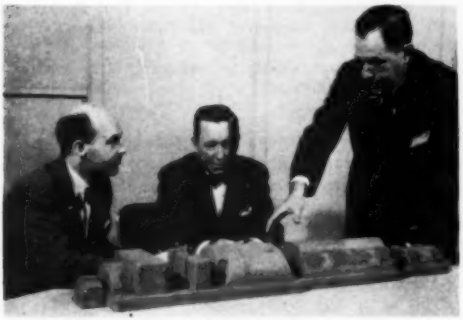
Left: Lyon employees plan "Get in the Scrap" week. The committee includes (left to right, clockwise): B. R. Skaggs, safety supervisor; D. K. Powelson, assistant advertising manager; Neal Ormond (partially hidden), director of personnel relations; L. S. Morrill, production planning supervisor; O. M. Konrath, general production manager; A. F. Aldis, plant superintendent; Dan Corsolini, assistant superintendent; Gene Dow, chief production engineer; and J. G. Schlindwien, toolroom superintendent

tions formerly obtained by the use of rotating regulators and, in some cases, electronic equipment. The new winder will handle heavy 234 in. wide kraft board at operating speeds up to 5000 fpm at a southeastern paper mill.

Magnetic amplifiers will provide voltage regulation of the system and current-limit control during acceleration and deceleration of the winder, as well as constant-tension regulation of the braking generator with provision for inertia compensation. The magnetic amplifier is a static device consisting of electric coils on an iron core, something like a transformer. It has no bearings, commutator, brushes or electronic tubes, reducing control maintenance to a minimum.

New Jersey Utility Will Install First 1100 F, 2350 Psig Turbines

Two 145,000 kw turbines, now being built by the General Electric Company's Turbine Divisions for the Kearny Station of the Public Service Electric and Gas Company of New Jersey, are the first ever designed for operation at 1100



Inspecting model of 145,000 kw turbine are (left to right) E. E. Parker, manager of engineering for G.E.'s Turbine Divisions; F. P. Fairchild, chief engineer, Public Service Electric and Gas Co. of New Jersey, and his associate H. Weisberg, mechanical engineer

F and 2350 psig. According to engineers, these new 3600 rpm, tandem-compound, triple-flow turbine-generators mark a step forward in the industry's continuing efforts to generate more electric power with less fuel consumed for every kilowatt-hour produced.

With the application of increased temperatures and pressures made possible by improved turbines, boilers, and auxiliary equipments, the utility industry's consumption of coal now averages only 1.15 lb per kwhr.

High-temperature turbines now in operation at 1050 F produce 1 kwhr for every 0.75 lb of coal consumed. The new 1100 F turbines are expected to decrease the amount of coal necessary per kilowatt-hour.

News of Chemical Exposition Reflects Industrial Speedup

News of the 23rd Exposition of Chemical Industries reflects the great industrial expansion in the industries dependent upon chemistry or the application and use of chemical products. The needs for the products of these industries are tremendous and their needs for machines, equipment instru-

(Continued on page 114)

Two Stage Split Case Pump for high-head service.

General Service Unipump for use where space is limited.

Non-clogging type "U" for liquid carrying solids.

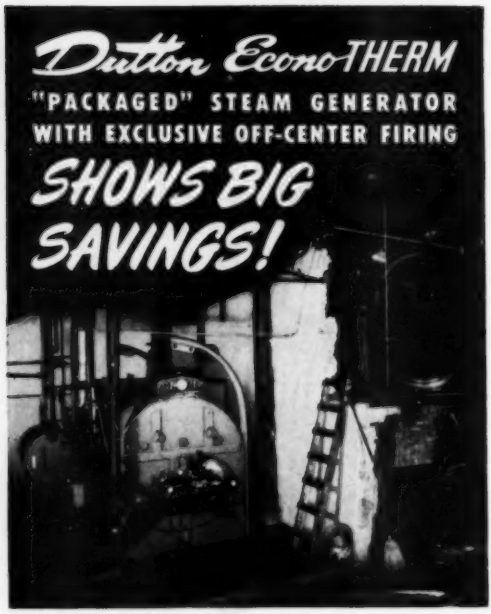
Because plants take their pumping systems for granted a pump break-down most often comes as an expensive surprise.

It's reassuring to have the stamp of approval placed on your plant's pumping system by a WEINMAN Centrifugal Specialist. This man is thoroughly familiar with your requirements. The company that he represents has been a leader in this field since before the turn of the last century. He has earned his title "CAREER MAN IN PUMPS."

It will pay you to invite this man through your plant. His recommendations will help you NOW.... will help prevent trouble LATER. Just write, wire or phone TODAY.

Representatives in Principal Cities

The WEINMAN Pump Mfg. Co.



HERE'S WHAT OFFICIALS SAY AT W. B. PLACE & COMPANY, HARTFORD, WIS., CUSTOM DEERSKIN TANNERS:

"We are very much pleased with the Dutton gas-fired boiler . . . it has done an excellent job of heating, and been practically trouble free." As to cost of operation, *"our bills to date indicate a substantial saving . . . a big saving in labor."*

From the installation picture, you might compare the *appearance* of these boilers—but where *efficiency* begins, comparison ends! The compact Dutton EconoTHERM produces *160 h.p.*, against *90 h.p.* for the space-consuming old boiler beside it. From a cold start, the Dutton will produce 125 lbs. of steam pressure in just 15 minutes. The old unit took 2½ hours!

In Hartford—or wherever they're installed—"packaged" EconoTHERMS win praise for fuel efficiency, safety and durability. Delivering *twice* the power you'd expect in *half* the usual space, the EconoTHERM is self-contained, with fully automatic controls.

Exclusive Dutton "off-center firing" with rotary combustion gives you faster boiler water circulation, plus greater safety. Other features include: Large steam storage space . . . five or more square feet of water heating surface per rated h.p. . . . mechanical draft with short stack (no costly chimney) and choice of gas or oil-firing.

Learn about *all* the quality features of the Dutton EconoTHERM . . . WRITE NOW FOR BULLETIN EC-100B

Other types and sizes — 5 to 250 h.p.

Dutton BOILER DIVISION
HAPMAN-DUTTON COMPANY
KALAMAZOO • MICHIGAN
Boiler Makers Since 1880

Spot news

(Continued from page 113)

ments, materials, services, technical products are increasing vastly. These are the products which will be shown in more than 400 exhibits at the exposition in Grand Central Palace, New York, November 26th to December 1st, filling all four floors to capacity.

With every exhibitor showing from one to a dozen or more new products, the itemized catalog of introductory displays will run into thousands. Many chemical substances have been developed as a direct result of the program for national defense, bringing with them by-products as offshoots from the necessary research, swelling the number of new products. New materials and processes for speeding up production of materials already in use have sparked the improvement of processing equipment to a greater extent than ever before, increasing the volume of such displays.

The chemical process industries are estimated to be spending five and a half billion dollars for new plants and equipment this year and twenty-seven billions more for raw materials. Chemical substances and materials produced by chemical methods are used by all industries. Hence the Exposition, though strictly technological, is all embracive in its business influence.

Rust Preventive Saves Metal Parts During Flood At Caterpillar's Kansas City Plant

After the waters receded in the wake of the worst flood ever to hit Kansas and Missouri, Caterpillar Tractor Co. began an immediate spot check of its metal parts stored there. Most of them withstood the ravages of corrosion because of a protective coating called Clear Coat, made by the Nox-Rust Chemical Corp.

This rust-preventive compound, which Caterpillar uses

(Continued on page 156)

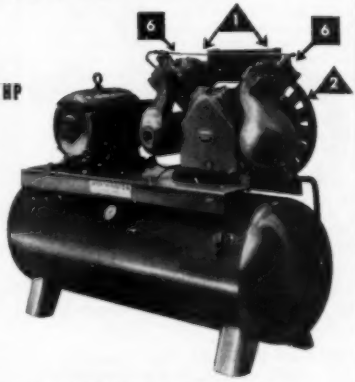
DEMONSTRATE DRY CHEMICAL FOR TRANSFORMER FIRES

Spectators at Walter Kidde Proving Ground saw this technician put out a roaring electrical transformer fire in two seconds with dry chemical from 20 lb portable extinguisher

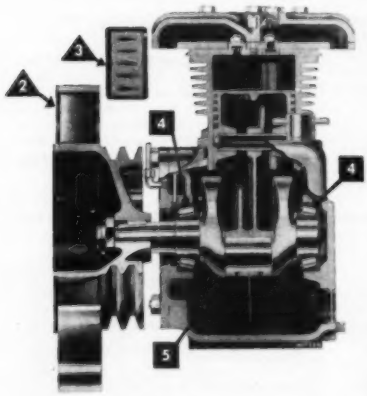
What to Look for to Get Lowest-Cost Compressed Air

Features that mean
MOST WORK PER CONSUMED HP

1. Isolated cylinders for greatest heat radiating surface
2. Large-capacity fan for most effective cooling
3. Radiator-type intercooler for maximum efficiency



Features that mean **SMOOTHEST OPERATION, LONGEST LIFE**



4. Timken main roller bearings for durability
5. Drop-forged crankshaft with integral counterweights
6. V-type cylinder arrangement for best balance

OR—A STILL EASIER WAY

Look for the name "WORTHINGTON". Worthington Balanced Angle Air Compressors with exclusive Feather* Valves give you as much as ⅓ more capacity per hp.

*Reg. U. S. Pat. Off.

In a Pressing Emergency...

The Distributor Delivers!

A laundry customer of Charles A. Templeton, Inc. suffered the shutdown of all its pressing machines due to the sudden collapse of an ancient air compressor.

But a quick call to this Waterbury distributor dispatched a Worthington unit, and within an hour the pressure was on.

Which proves how wise it is to buy your air compressors from your nearby distributor.

The Worthington distributor is the *only* one with a *complete* air compressor line—⅓ up to 125 hp.

So—when the pressure is on you—call your Worthington distributor. Meanwhile, send coupon for free bulletin.

MAIL COUPON FOR FREE BULLETIN

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WORTHINGTON

THE GOOD RIGHT HAND OF INDUSTRY

POWER TRANSMISSION: sheaves, V-belts, variable speed drives

PUMPS: centrifugal, power, rotary, steam

AIR COMPRESSORS: water-cooled, air-cooled

Worthington Pump and Machinery Corporation
Merchandising Division
Harrison, N. J.

Send bulletin H620-B30 on Worthington Balanced Angle Air-Cooled Air Compressor line.

Name.....

Company.....

Address.....

City.....Zone..State.....

News
of men and companies

HONORS

General Electric Co.—The medal of honor of the Institute of Radio Engineers has been voted to Dr. W. R. G. Baker, v-p and general manager of the Electronics Div.

Acme Steel Co.—H. L. Bills, v-p, will receive the annual industrial relations achievement award of the National Metal Trades Association.

ANNIVERSARIES

Metals Disintegrating Co., Inc.—In commemorating its 35th anniversary, plans were announced to honor thirty-five of the oldest and foremost leaders in the metal powders industry.

SALES OFFICES

The Babcock & Wilcox Tube Co.—District sales headquarters formerly established at the plant, moved to 712 Eleventh St., Beaver Falls, Pa.

Chain Belt Co.—Cate Equipment Co., located at 49 E. 9th South, is new district sales office in Salt Lake City.

De Laval Steam Turbine Co.—New building at 160 Folsom St., will house San Francisco headquarters for sales and service activities under direction of C. F. Reeves.

Edward Valves, Inc.—Pittsburgh sales office has moved to the Investment Bldg., 235 Fourth Ave. T. E. Skilling continues as district sales mgr.

Hagan Corp.—Three sub-offices of the Chicago district office have been opened. They also serve Hall Laboratories, Inc., Calgon, Inc., and The Buromin Company, subsidiaries. A. Soderberg is in charge of the sub-office at Rockford, Ill.; W. Chapman is in charge at the Peoria sub-office; and, O. Lessa directs the Indianapolis office.

Lucas-Milhaupt Engineering Co.—Chicago div. headed by H. Olson now located at 333 N. Michigan Ave.

Minnesota Mining & Mfg. Co.—Sales office and warehouse now established in Dallas, Tex., at 1221 Dragon St. Officials in charge are W. F. Gruetzman, R. Paulson, and F. Richardson.

The Swartwout Co.—New sales office in M & M Bldg., Houston, will service the Texas area. Sales engineers are J. B. Downey and W. A. Sharp.

Whitney Chain Co.—San Francisco sales office now at 70 Dorman Ave., under the direction of G. F. Haag, district manager.

NEW REPRESENTATIVES

Flexitallic Gasket Co.—Six new agents were added to the field organization. They include: Jno. D. Hiles Co., Inc., Pittsburgh; Engineering Products Co., Charleston, W. Va.; Chapman Engineering Sales Co., Cincinnati; De Haven Engineering Co., Indianapolis; Steel & Engineering Products Co., El Paso; and, Energy Control Corp., Philadelphia.

COLLEGE PROFESSORS PRACTICE WHAT THEY TEACH

Nineteen college professors — representing the leading engineering colleges of the country—augmented their textbook knowledge last summer by working side-by-side with engineers and workmen of the Westinghouse Electric Corp. The industrial experience program, begun several years ago, not only gives such professors the opportunity to practice what they teach, but furnishes them with an insight into the engineering needs and problems of industry.

J. C. McKeon, manager of university relations, points out that the principal object of the program is the development of a more competent engineering graduate, and one who can more easily make the transition from the campus to the ranks of industry.

The professors were given assignments relating to their particular fields of study.

Chiksan Co.—Hydrobel, S. A., Liege, Belgium, has been appointed export sales representative for Belgium, Grand Duchy of Luxembourg and the Belgian Congo.

Gorham Tool Co.—Sonnet Supply Co., Hawthorne, Calif., is West Coast distributor.

Container Corporation of America—Sefton Fibre Can Co., subsidiary, will open new plant in Piqua, Ohio, shortly.

EXPANSIONS

Aluminum Company of America—New production facilities are planned at an existing plant in Mobile, Ala., by Aluminum Ore Co., a subsidiary. The company is also currently erecting a new alumina works at Bauxite, Ark.

(Continued on page 118)

Welcoming Japanese Diet delegates during visit to the Cooper-Bessemer plant are B. B. Williams and H. A. Gehres, company officials. Delegates are K. Kimura, A. Okanishi, T. Ono, E. Kobayashi, H. Yamahana, T. Takeshita, M. Aoki, S. Sugita

Eight delegates of the Japanese Diet (Parliament) recently devoted several days in research at Mount Vernon, Ohio, gathering first hand data on American community life in a "typical American small city". To obtain an accurate cross section of a typical American industrial plant, the delegates visited The Cooper-Bessemer Corp.

As a result of a motion picture produced several years ago by the State Dept., to portray life in an average American community, these delegates asked specifically to visit Mount Vernon and The Cooper-Bessemer Corp.

During an instructive visit into the plant, they witnessed American productivity in action, watching workers apply incentive skill to modern precision machine tools. Particularly impressive to them was the quantity of work turned out by the workers.

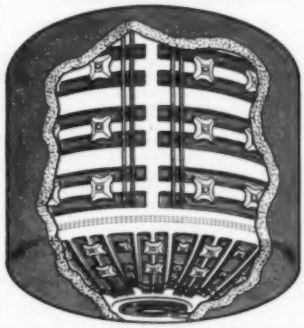
Appreciation was expressed for the desire of Americans to help the Japanese rebuild their war-torn nation. With such help, Japan is currently making encouraging progress that is effectively aiding them to combat communism.

Industry's Most Versatile Heat Source

Chromalox *Electric* Strip Heaters

Easy to Install CHROMALOX Electric Strip Heaters give clean, dependable and accurately controlled heat where and when heat is needed. They produce uniform and accurate temperatures by automatic or manual controls. Low initial costs, low installation costs and low operating costs are among the many advantages of using CHROMALOX Strip Heaters for heating liquids, gases, viscous fluids, tanks, platens, molds, moving parts, etc. Get the full details now.

A Typical Strip Heater Application from Our Files



Rugged, easily installed Chromalox Strip Heaters assure accurate temperature, dependable around-the-clock service.

Strip Heaters curved slightly as installed conform to shape of convex kettle bottom, while . . .

Strip Heaters curved lengthwise at the factory fit snugly to tank perimeter and . . .

Segment Heaters fill the gaps.

IC-99

CHROMALOX

Electric Heat for Modern Industry

Sizes, Types and Sheaths for Every Need
LENGTHS
4" to 96" lengths, ½" to 2½" widths, rings 2½" to 11" diameter 115 to 460 volts
CURVES & SEGMENTS
Curved in cross-section or formed lengthwise to desired radii
TERMINALS
Varied terminal types for convenient wiring. 2 terminals at one end, centered, or at opposite ends. 3 terminals at same end of the unit
SHEATHS
Rust-resisting iron, high temperature steel and Monel sheaths to meet exact service conditions

Want Ideas?

on how to use Chromalox Electric Heaters in your plant

Write for the data-packed Catalog 50 which describes many types of Chromalox Electric Heaters and how to apply them. It's yours without obligation.

EDWIN L. WIEGAND COMPANY
7520 Thomas Blvd., Pittsburgh 8, Pa.

This
Trap Responds
Instantly
to
Load Change

Heavily constructed to give the true economy of long life, B&J Traps can handle sudden and large condensate loads efficiently, regardless of temperature. The thermostatic element vents air rapidly.

Made in five sizes for loads up to 5750 lbs. of water per hour. Working parts readily accessible for easy maintenance — the thermostatic element, valve piece and seat are locked in adjustment in a cage unit, only one piece to replace, no special tools needed.

Write for full details — *do it today.*

B&J

BARNES & JONES
INCORPORATED
128 BROOKSIDE AVENUE
BOSTON 30, MASS.

Representatives in all principal cities

News

of men and companies

(Continued from page 116)

The Babcock & Wilcox Co.—Expanded use of subcontracted facilities, plus plans for a new plant, have been made. The facilities are at Wilmington, Del., Wilmington, N. C. and Dallas, Texas. The new plant will be located at West Point, Miss.

Barnes Mfg. Co.—Assets of the Shasta Pump Co. located in Oakland, Calif., were purchased. The new organization will be known as Barnes-Shasta Pump Co.

Borg-Warner Corp.—Contruction of a $3,000,000 plant at Wooster, Ohio, for the manufacture of electrically driven hydraulic and fuel pumps for jet engines, will begin early in October.

Bowser, Inc.—Ownership of National Scientific Laboratories, Inc., Washington, D. C. has been acquired.

Chicago Metal Hose Corp.—One-story brick plant totalling 120,000 sq ft. for the fabrication of aircraft assemblies and components, is being constructed at Memphis, Tenn.

Electronic Devices, Inc.—The purchase, for purposes of expansion, of Precision Rectifier Corp. which will be operated as the Precision Rectifier Div. is announced.

Hyatt Bearings Div.—Preliminary plans are now complete for expansion of the manufacturing areas in both Harrison and Clark Township, N. J. plants. New structures and alterations will provide an additional 402,000 sq ft.

Kirk & Blum Mfg. Co.—Primary phase of an extensive modernization of plant facilities has been completed. More is to follow.

Lakey Foundry & Machine Co.—Plans for installation of an improved mechanical charging system and a new and larger cupola costing $250,000 in No. 5 foundry were announced.

National Gypsum Co.—Completion of new paper mill at Pryor, Okla. is expected in October, with machinery installation to be completed by December.

Rockwell Mfg. Co.—The name of the Ohlen-Bishop Manufacturing Company, Columbus, Ohio, a subsidiary, has been changed to Rockwell Tools, Inc.

Sterling Electric Motors, Inc.—Contracts have been let for construction of a one million dollar plant in Van Wert, Ohio. The plant is designed for production of precision gearing system for the aircraft industry.

United Manufacturing Co.—New plant, located at 32 Interstate Street in Bedford, Ohio, will double present facilities.

United States Steel Corp.—Gibbs & Hill, Inc. was awarded a contract for the engineering, design, and construction of a 60,000 kilowatt electric power station for the Fairless Works of the company, now under construction near Morrisville, Pa. In addition, the New York engineering firm will undertake the engineering and design of mains to bring blast furnace gas to the power station as a fuel and of an underground 13.8 kilovolt electrical system.

APPOINTMENTS

Abrams Instrument Corp.—B. W. Manth was appointed production manager.

Allis-Chalmers Mfg. Co.—The following changes were made by the board of directors. W. G. Scholl, was named v-p in charge of sales for the tractor div., and C. W. Schweers, was named v-p in charge of sales for the general machinery div. J. F. Roberts, was named v-p in charge of engineering for the general machinery div., and W. A. Yost was named a v-p of the general machinery div. G. F. Langenohl, was elected treasurer and appointed assistant secretary. N. D. Johnson, assumes additional responsibilities as assistant treasurer.

American Cladmetals Co.—G. I. Clark was appointed project engineer.

American Engineering Co.—R. C. Davis, is now sales manager of the power plant div. with headquarters at the general offices in Philadelphia, Pa. N. Dotzenroth succeeds Davis as district manager in the Chicago area.

J. L. Mohun **R. C. Davis**

Baldwin-Hill Co.—The appointment of J. L. Mohun as div. manager, industrial insulation sales, has been announced. He will be located at the new sales office established at 4101 San Jacinto Street, Houston 4, Texas.

American Floor Surfacing Machine Co.—J. B. Lynn was named advertising manager.

The Austin Co.—A. D. Engle was appointed assistant v-p for research. His headquarters will be at the general offices in Cleveland.

Burlingame Associates—P. Lahana was appointed to the staff of field engineers. He will serve the Western New England area.

Corning Glass Works—Executive promotions include J. L. Ward to assistant controller with J. L. Hanigan succeeding as general manager of the electrical products div. N. J. Vang becomes manager of manufacturing for the div.; P. T. Clark has been named

manager of the Pressware plant in Corning; and, J. H. Allen succeeds Clark as manager of the Fall Brook plant.

Diebold, Inc.—E. F. Collins was named sales manager of the Visible Records Equipment Div.

The Dow Chemical Co.—Dr. M. E. Putnam has been elected to the newly created position of executive v-p. D. L. Kenaga joined the wood preservation laboratory. W. H. Jones, formerly supervisor of administrative and service departments at the Madison Div., is promoted to production and economic coordinator of the magnesium dept.

Ebasco Services Inc.—C. F. Terrell is appointed general manager in Greece replacing W. H. Burke who is returning to this country in October. L. Sharkey has joined the staff of the rate department as a rate consultant.

The Electric Products Co.—J. Thompson has joined the Chicago agency.

General Controls Co.—H. B. Safford, Jr. is appointed to advertising and sales promotion manager. J. Fallon, formerly in charge of the Cincinnati office is appointed factory branch office manager for the new location in Columbus, Ohio. Purchase of the assets of Grayson-Greenamyer, Inc. of Monrovia is completed. R. Grayson takes over as general manager of the newly-formed Grayson-Greenamyer appliance controls div. plant; Greenamyer is appointed works manager and John Grayson is retained as director of research and development.

General Electric Co.—W. F. Rauber, manager of sales of the switchgear dept. in Philadelphia, has been named special representative of the Large Apparatus Div. in Washington, D. C. C. E. Burke, manager of sales of the specialty transformer and ballast dept., Fort Wayne, was appointed to succeed Rauber.

The General Tire & Rubber Co.—R. W. Henderson, operating manager of the San Francisco branch, has been promoted to assistant branch manager. J. Wheeler has been appointed works manager of the Bowling Green Div. H. Williams has been named special representative in Washington, D. C., for the industrial and general products sales department. He succeeds the late R. H. Whitney.

Graver Water Conditioning Co.— H. R. Fosnot was made eastern sales manager with headquarters at the home office.

Hyatt Bearing Div.—This division of General Motors Corp. announces the appointment of F. H. Webster as assistant manager, Western Div., Chicago.

Illinois Institute of Technology—P. B. W. Gollong has joined the international div. at Armour Research Foundation. Gollong left in September for an eight-week survey of the personnel needed for industrial development programs in Pakistan and India.

"Small-Boiler Operators... Now you can even collect nuisance dust from natural draft boilers!"

Buell 'LR' Collector Proves Highly Efficient for Boilers from 100 to 2,000 BHP!

Now, with the new Buell 'LR' Dust Collector, you can meet today's dust abatement demands. For, the 'LR' Collector gets 99% of all 100-mesh, and larger, cinder discharge.

What's more—draft loss with the 'LR' is so low—you can even use it on the smallest natural draft boilers.

For full information on how the Buell 'LR' Dust Collector can help you solve your Fly Ash problem, write today. Ask for the new 'LR' bulletin. Buell Engineering Company, Dept. 90-J, 70 Pine Street, New York 5, N. Y.

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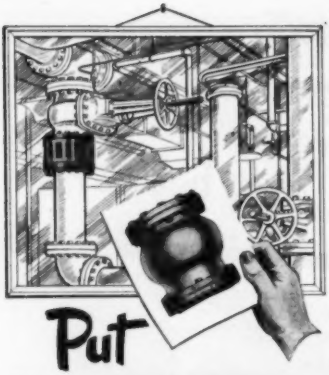
Engineered Efficiency in **Fly Ash Collection**



Put
WILLIAMS-HAGER
flanged
Silent CHECK VALVES
into the Picture-

and your
WATER HAMMER
WORRIES ARE OVER

When you install Wiliams-Hager flanged Silent Check Valves in your water system, you complete the happy picture of a plant . . . rid of costly water hammer. These dependable valves provide positive protection in any position including angular, horizontal and vertical with flow either upward or downward. Disc and seat are renewable—conical spring is non-wearing. Easy to install or reseat, they are available in standard pipe sizes from 1" to 20".

Write today for Bulletin WH-100.

CHECK VALVES

THE WILLIAMS GAUGE CO.

Pump Valves . . . Water Gauges . . . Gauge Cocks . . . Steam Traps . . . Pump Governors . . . Feed Water Regulators . . . Water Columns

3100 PENNSYLVANIA AVE. • PITTSBURGH 33, PA.

News

of men and companies

(Continued from page 119)

A. C. Kirkwood & Associates—Thomas C. Kirkwood is now a member of the firm.

Leeds & Northrup Co.—Dr. R. C. Machler, is named director of research and a member of the executive committee, succeeding I. M. Stein recently elected to the newly created post of executive v-p.

Link-Belt Co.—R. E. Lambert has been appointed assistant superintendent at the Dodge plant in Indianapolis.

Midwest Piping & Supply Co., Inc.—Appointment of J. E. Brock as director of research is announced. He will make his headquarters at the main plant and executive office in St. Louis.

Monsanto Chemical Co.—H. M. Mitchell has been appointed personnel manager of the Plastics Div.

Oerlikon Tool and Arms Corp. of America—Lt. Gen. K. B. Wolfe (retired, U.S.A.F.) has been elected president of the newly organized company. The company is now making surveys for the location of one or more plants which, it is expected, will be located in the east. The company's plans also call for the substantial use of existing facilities for subcontracting.

Ohio Hoist & Mfg. Co.—W. A. Spence has been appointed general manager.

Owens-Illinois Glass Co.—J. A. Corcoran has been assigned to the New York branch office of the Kaylo Div., reporting to D. Innes, branch manager.

Products Engineering Co.—Formation of a machinery rebuilding div. under the direction of Martin Kaufman is announced.

Raybestos-Manhattan, Inc.—A. L. Hawk was named assistant manager of the western sales district, Manhattan Rubber Div. S. V. V. Hoffman was appointed regional manager of the west coast sales div. Other advancements announced are the appointments of A. N. Johnston, Jr. as assistant manager of the central sales district, and of D. H. Cottrille as West Virginia regional manager.

Joseph T. Ryerson & Son, Inc.—P. L. Wright is appointed sales manager of the Buffalo, N. Y. plant.

The Trane Co.—D. C. Minard was elected president succeeding R. N. Trane who was advanced to the newly created post of chairman of the board.

Union Carbide and Carbon Corp.—The appointment of Dr. J. F. Eversole as manager of research administration was announced.

Union Malleable Mfg. Co.—S. J. Jacobson was elected to the office of president of the parent company and its subsidiaries. He succeeds his late brother, Jack Jacobson.

Wagner Electric Corp.—M. B. Atkinson became manager of the Detroit office succeeding R. L. Wells who retired after 40 years service. A. W. Maas was appointed manager of the San Francisco electrical office succeeding E. D. Pike who retired after 49 years with the company.

Elliot Co.—A. P. Wendland has been appointed manager of the general service dept. with headquarters at Jeannette, Pa. He succeeds the late Frank Murphy who had been service manager since 1918.

A. P. Wendland **T. O. Schrader**

Erie City Iron Works—T. O. Schrader, sales manager, has been elected v-p.

Westinghouse Electric Corp.—C. W. Miller has been named manager of large power transformer engineering for the Transformer Div. He succeeds the late W. G. James, who died recently. Men who will head production at the new plant being built in Columbus, Ohio are: C. L. Van Derau who becomes general works manager in charge of both the Mansfield and Columbus plants; E. L. Smith, former purchasing agent, becomes works manager at Columbus; C D. Heaton, former superintendent of refrigeration assembly at Mansfield, is named manager of manufacturing at Columbus; and John B. Roman, former works engineer at Mansfield, will assume the same duties at Columbus. R. R. Longwell has been appointed Baltimore engineering and service manager; and G. E. Grosser has been appointed district consulting and application engineering supervisor, with headquarters at Philadelphia, Pa. The Electronics and X-Ray Div. has appointed C. London manager of electronics service.

The Brooks Oil Co.—R. T. Joyce, company secretary, is appointed also manager of operations.

The Reliance Electric & Engineering Co.—P. W. Arnold, who served as manager of product sales, moves up to the newly created post of executive ass't to the sales v-p. R. A. Geuder, who has headed application engineering work, becomes manager of a new department of applied engineering and industry sales.

The Rawplug Co., Inc.—F. B. Powers succeeds the late W. R. Howard as president.

Rockwell Mfg. Co.—H. A. Altorfer was appointed chief engineer, Nordstrom Valve Div.

(Continued on page 122)

—ONE JOHN ZINK STOP—
BURNER SERVICE

COMBINATION GAS & OIL BURNERS
FOR EITHER VERTICAL or HORIZONTAL FIRING

Between - the - Tube BURNER

The application of the John Zink patented ST Gas Burner to industrial or power boiler installations is a radical improvement in boiler firing.

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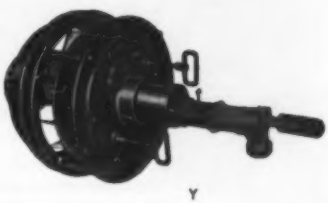

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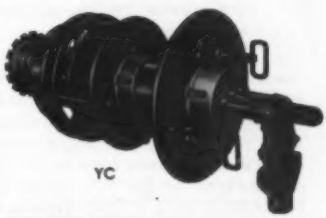

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Saunders patent diaphragm valves

Proportioning Pumps

Force-Feed Lubricators • Magnesium Alloy Castings

News

of men and companies

(Continued from page 120)

Sam Tour & Co., Inc.—D. Ord has joined this organization and will be located in the research and development laboratories.

U. S. Rubber Co.—H. G. Smith, v-p and general manager of the textile div., has been named to the newly created post of executive v-p. The position was created because H. E. Humphreys, Jr. has been called upon to do double duty as president and chairman. W. E. Clark assistant general manager of the textile div., has been elected a v-p and made general manager of the div.

A. O. Smith Corp.—J. G. Goodwille has joined as industrial safety grating product supervisor. A. E. Treen is named manager of personnel and purchasing at the Houston works succeeding F. B. Dunn who has resigned. J. B. Madden has been appointed hydraulic sales manager for the north central district.

J. G. Goodwille **B. K. Wickstrum**

Sylvania Electric Products Inc.—B. K. Wickstrum was elected to the post of v-p and director of sales. He succeeds R. H. Bishop, who has resigned to become a v-p of E. F. Drew & Co.

The Yale & Towne Mfg. Co.—F. P. Minnelli is appointed manager of a newly organized market research dept. of the Philadelphia Div.

Pabco Products, Inc.—R. W. Gray has been appointed administrative assistant to J. A. Ludwig, sales manager, Paint Div.

P.R. Mallory & Co.—C. Mercer, purchasing agent, has been appointed director of purchasing. W. J. Topmiller, Jr., former assistant, moves up to the post of purchasing agent.

Daystrom, Inc.—S. A. Sollie was named product manager of the Daystrom Electric Corp., a subsidiary.

OBITUARIES

Worthington Pump and Machinery Corp.—S. W. Kitson, 53, manager of the Public Works Div. passed away recently in Boston, Mass.

Reviews of recent books

Recent books, published for men responsible for the Engineered Plant Services, are reviewed here. Write to the publisher for those in which you are interested

Condenser Standards

"Third Edition of Heat Exchange Institute Standards for Barometric and Low Level Jet Condensers", published by the Heat Exchange Institute, 122 East 42nd St., New York 17, N.Y. Price $1.00.

The Heat Exchange Institute announces the publication of the Third Edition of Heat Exchange Institute Standards for Barometric and Low Level Jet Condensers. The publication covers such important phases as nomenclature, definitions and standards for condenser performance, and information required in the calculation of water requirements. Also covered are vacuum pump capacity, installation, information on atmospheric relief valves and a series of conversion tables, useful in calculation and installation of this type of jet condenser.

This publication takes its place in the series of Heat Exchange Standards, which have been published from time to time by the Institute.

Chemical Plant Library

"Chemical Plant Library", by James A. Lee. Published by McGraw-Hill Book Co., 330 West 42nd Street, New York 18, N.Y. Illustrated. 2359 pages in 5 volumes. Price $24.50.

Every page of this 5-volume set is packed with plant-tested information on vital subjects of chemical plant work—calculations, economics, unit operations, production and supervision and materials of construction. It is up-to-date and represents the boiled-down experience of others that would take the individual a lifetime to accumulate.

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All the information contained is clearly indexed for immediate use. In a matter of minutes, you can have at your fingertips guidance on how leading plants manufacture chemicals and chemical products, how to operate chemical plant equipment efficiently, what construction materials do the best job of resisting chemical corrosion, how to speed up and simplify calculations when designing chemical processes, and how to handle the "business" side of the industry with confidence.

Meetings and exhibitions

Announcement of coming meetings that will aid executives and engineers in planning itineraries. For additional information, please write sponsors of meetings

OCTOBER

American Standards Association will hold its National Standardization Conference in the Waldorf-Astoria, New York, Oct. 22-24. Emphasis will be on standards in national defense. Write ASA, 70 East 45th St., New York, for conference information.

National Association of Corrosion Engineers holds the annual meeting of the South Central Region at Corpus Christi, Texas, October 18-20. G. A. Mills, Central Power and Light Co., is general chairman of the meeting.

The Engineers' Society of Western Pennsylvania holds its 12th Annual Water Conference at Hotel William Penn, Pittsburgh, Oct. 22-24.

American Institute of Electrical Engineers has scheduled the fall general meeting for Cleveland, Oct. 22-26.

NOVEMBER

23rd Exposition of Chemical Industries will use all available exhibit space on the exposition floors of Grand Central Palace, New York, from Nov. 26 to Dec. 1. Write Publicity Department, 23rd Exposition of Chemical Industries, Grand Central Palace, New York.

National Metal Trades Association holds its 52nd Annual Convention at the Blackstone Hotel, Chicago, Nov. 14-16.

JANUARY

The Plant Maintenance Show will be held at Convention Hall, Philadelphia, Jan. 14-17, 1952. Write Clapp & Poliak, Inc., 341 Madison Ave., New York 17.

MARCH

National Association of Corrosion Engineers holds its Eighth Annual Conference and Exhibition at the Pleasure Pier in Galveston, Tex., Mar. 10-14, 1952.

MAY

International Lighting Exposition and Conference will be held at Cleveland, May 6-9, 1952.

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For a quick, depndable check on CO_2 content of flue gases, use RANAREX! It's a sure check that is accurat to within 3/10 of 1% of CO_2. Ranarex uses no chemicals, is sturdily constructed and easily maintained.

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(a55)

Readers' guide to advertised products

This department is both a product index for advertising and a keyed listing for advertised literature. List paragraph key numbers on reader service card to get data you want.

See Reader Service Card Page 132

AIR & DUST FILTERS & COLLECTORS

501—See page 119. Dust Collector: Write for 'LR' bulletin with complete data on the Buell 'LR' Dust Collector that can help you solve your fly ash problem. Buell Engineering Co.

ANTI-CORROSIVE & PROTECTIVE COATINGS

502—See page 39. Rust Preventive: Rust-Oleum seals metal so that no rust-causing oxygen can reach it. Available in a full range of colors. Write for complete data. Rust-Oleum Corp.

503—See page 133. Rust Preventives: Mail coupon to obtain your copy of No-Ox-Id Check-Chart and Plant Maintenance Survey. Or ask for a Dearborn representative to call. Dearborn Chemical Co.

BOILERS & BOILER ACCESSORIES

504—See page 63. Vane Control: Write for new Bulletin DB 92-810 which describes the mechanical improvements developed for Sturtevant Vane Control and its use in mechanical draft, industrial and ventilating applications. Westinghouse Electric Corp., Sturtevant Div.

505—See page 165. Steam Generators: Write for descriptive literature on Wickes complete line of steam generating equipment or consult nearest Wickes representative. Wickes Boiler Co.

506—See page 33. Steam Generators: Mail coupon on page 33 for catalog and desk demonstration of Clayton Forced Recirculation Steam Generators. Clayton Mfg. Co.

507—See page 150. Boilers: Kewanee firebox boilers are especially adapted for high pressure—10 to 304 hp, 100, 125, 150 lb wp. Write for details and 6" scale with pipe diameter markings. Kewanee Boiler Corp.

508—See page 7. Boilers: You will profit by consulting with Union engineers for correct steam generating units for your specific requirements. Your inquiry invited. Union Iron Works.

509—See page 157. Continuous Blowdown: Send for Catalog 68-J and a copy of this concern's Continuous Blowdown Check-Chart. Systems available for pressures up to 1500 psi. Strong, Carlisle & Hammond Co.

BUILDING HEATING, VENTILATING & AIR CONDITIONING & REFRIGERATION

510—See page 48. Air Conditioning: Whatever your heating, cooling, ventilating or air conditioning problem is, look for the answer in the complete Trane line. Write today. The Trane Co.

BUILDING MATERIALS & MAINTENANCE

511—See page 131. Electroforged Steel Grating: See page 131 which lists 5 built-in advantages found in Blaw-Knox electroforged steel grating. Write for complete data. Blaw-Knox Div. of Blaw-Knox Co.

512—See page 152. Floor Patch: Write for free folder on Smooth-On quick floor patch cement and 40-page metal repair handbook. Smooth-On Mfg. Co.

513—See page 136. Maintenance Handbook: Mail coupon on page 136 for free 40-page handbook on Commutator and Slip Ring Maintenance. Ideal Industries, Inc.

514—See page 143. Pipe Joint Compound: Pipe joints and fittings sealed with Key sealing compounds do not leak. Connections will not freeze and reopening is easy. Send for free sample. Key Company.

For your free copies of this new literature and more data on advertised products, list the key numbers of the descriptive paragraphs on one of the handy order cards on pg. 132. Mail today—postage-free!

515—See page 163. Floor Patch: Tough, plastic material which restores broken concrete to solid smoothness. Write for details of free trial offer and "Hand Book of Building Maintenance". Flexrock Co.

COAL, ASH & BULK HANDLING

516—See page 129. Coal: See page 129 for four basic advantages of Southern's industrial coals. Write for profitable engineering counsel today. Southern Coal Co., Inc.

517—See page 135. Dewaterizer: Write for complete information on Hewitt-Robins Eliptex Dewaterizer for surface moisture removal in processing many bulk materials. Hewitt Robins.

COMPRESSORS

518—See page 115. Compressors: Send coupon on page 115 for Bulletin H620-B30 on Worthington Balanced Angle Air-Cooled Air Compressor line. Worthington Pump & Machinery Corp., Merchandising Div.

519—See page 58. Compressors: Consult the Fuller engineer for further information on Fuller rotary compressors with life-time capacity. Fuller Company.

520—See page 37. Compressors: Mail coupon on page 37 for free Booklet C-50 on installing Schramm stationary air compressors. Schramm, Inc.

521—See page 147. Compressors: Write for Bulletin 726—C describing these duplex synchronous motor-driven compressors in sizes from 6,000 to 12,000 cfm piston displacement at 100 lbs pressure. Chicago Pneumatic Tool Co.

CONTROLS, REGULATORS & INSTRUMENTS

522—See page 60. Temperature Control: For complete details on the entire Spence line of automatic regulating valves, strainers and desuperheaters, write for Bulletin 1200. Spence Engineering Co., Inc.

(Continued on page 126)

Readers' guide to advertised products

(Continued from page 125)

523—See page 57. Measuring Devices: Mail coupon on page 57 for brochures describing force measuring devices, push pull gages, traction dynamometers and laboratory scales. John Chatillon & Sons.

524—See page 150. Feed Water Meters: Write for complete data on Henszey meters that provide dependable, accurate measurement of boiler feed water, boiler blowdown, condensate, chemicals, and other similar liquids. Henszey Co.

525—See page 162. Tank Gage: Write for complete details on liquid level gages for measuring liquids of all kinds. Dial readings in feet, inches, gallons, pounds or any desired units. The Liquidometer Corp.

526—See page 123. Indicator and Recorder: For a quick, dependable check on CO_2 content of flue gases, use Ranarex. Write for free booklet. The Permutit Co.

527—See page 111. Intensifier: Write for new bulletin describing the Cooper-Bessemer intensifier for all high pressure testing. Available in two sizes. The Cooper-Bessemer Corp.

528—See page 4. Automatic Control: Consult the Johnson engineer for complete details on the Johnson automatic control system for dependable, precise regulation of heating, cooling and moisture content. Johnson Service Co.

529—See page 130. Regulators: Valve-in-end construction gives you simple, compact design built for maximum performance. Stets Type G regulators are setting new efficiency records daily. Write for Bulletin 150. Stets Co.

530—See page 151. Pressure Regulators: Write for complete data on Mason-Neilan No. 33 and No. 227 pressure regulators. Quality constructed for long operating life. Mason-Neilan Regulator Co.

531—See page 160. Temperature Regulators: Write for Stacon Bulletin 50-1000 for full details on extra sensitive, accurate, economical temperature regulators. Farris Stacon Corp.

532—See page 143. Gas Analyzer: Fyrite Gas Analyzer is available in two models—for direct CO_2 analysis and for direct oxygen analysis. Write for Leaflet 1-700. Bacharach Industrial Instrument Co.

533—See page 139. Thermometers: Write for literature describing Weston all-metal, as well as electrical and glass thermometers. Weston Electrical Instrument Corp.

534—See page 124. Controls: Marking 60 years of experience in heating, ventilating, air conditioning and process control, Powers Regulator Co. gives you better controls, deliveries and valves. Write for full details. Powers Regulator Co.

DEHYDRATION EQUIPMENT

535—See page 138. Hydryer: Pritchard hydryers are standard packaged units designed to reduce dew points of compressed air and other gases to minus 40° F. Write for Bulletin No. 16.0.080. J. F. Pritchard & Co.

ELECTRICAL DISTRIBUTION

536—See pages 14, 15. Unit Substations: Write for I-T-E Catalog 9000 that describes all types of secondary unit substation equipment and gives complete information on selection of distribution systems and equipment. I-T-E Circuit Breaker Co.

537—See page 141. Electrical Enclosures: Custom-built cubicles, cabinets and control boards. For a no-cost, no-obligation estimate, send a set of prints to The Kirk & Blum Mfg. Co.

554—See page 154. Wire-Pulling Compound: Send for free sample and literature on Albany RBR wire pulling compound for speed, ease and economy. Adam Cook's Sons, Inc.

ELECTRICAL HEATING UNITS

538—See page 117. Electric Heaters: Write for data-packed Catalog 50 which describes many types of Chromalox electric heaters and how to apply them. No obligation. Edwin L. Wiegand Co.

FANS AND BLOWERS

539—See page 2. Fans and Blowers: Send coupon on page 2 for complete information on Hartzell fans and blowers. Hartzell Propeller Fan Co.

FUELS & FIRING EQUIPMENT

540—See page 47. Burners: Use coupon in this advertisement to obtain Bulle-

GET BETTER CONTROL OF GASES • LIQUIDS OR SEMI-SOLIDS MANUALLY OR AUTOMATICALLY

✓ In Large Volume or Small
✓ At High or Low Pressure
✓ Cold, Normal or Hot
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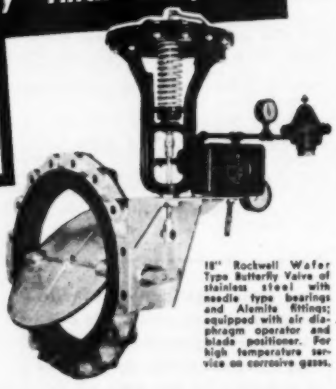

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18" Rockwell Wafer Type Butterfly Valve of stainless steel with needle type bearings and Alemite fittings; equipped with air diaphragm operator and blade positioner. For high temperature service on corrosive gases.

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W. S. ROCKWELL COMPANY • 230 Eliot St., Fairfield, Conn.

tin 410-6 with complete information on Coppus-Dennis Fanmix burners. Coppus Engineering Corp.

541—See pages 8, 9. Pulverizer: See pages 8, 9 that list the outstanding features of the new Riley "50" pulverizer. Write for complete details. Riley Stoker Corp.

542—See pages 40, 41. Stokers: Write for Bulletins with detailed information on Canton Stokers, or write the Canton Stoker representative nearest you. Canton Stoker Corp.

543—See page 59. Coal: If you have a coal problem, consult the Beacon Combustion Service Man for the type to fit your exact needs from the Beacon line of quality fuels. Eastern Gas and Fuel Associates.

544—See page 156. Fuel Oil Additive: Hought-Solv dissolves sludge fast, keeps new sludge from forming, and gives more Btu's for the money. Order a trial drum now. E. F. Houghton & Co.

604—See page 121. Burners: Write for literature on the John Zink Series CBM, Y and YC combination gas and oil burners and ST gas burner. John Zink Co.

HEAT EXCHANGER EQUIPMENT

545—See page 159. Water Heaters: Pick instantaneous water heaters are engineered to provide any volume of water at the temperature required. Write for details. Pick Mfg. Co.

546—See page 34. Oil Cooler: Write for Bulletin 702 with complete information on Sarco Blenders that provide constant temperature automatically of cooling water for engine jackets and oil coolers. Sarco Co., Inc.

605—See page 108. Freon Coolers: Send coupon on page 108 for Catalog 101 describing the P-K dry expansion type Freon Cooler designed for use with water and other fluids for air conditioning, refrigeration, industrial and process cooling applications. The Patterson-Kelley Co., Inc.

LUBRICANTS, LUBRICATION, OIL FILTERS & PURIFIERS

547—See page 144. Oil Purifiers: Write for free literature on the Hilco line of purifiers, filters, reclaimers and conditioners for every lubrication and fuel oil filtering problem. The Hilliard Corp.

548—See page 152. Lubricant: Write today for case histories of savings made through the use of Lubriplate in your industry. Lubriplate Div., Fiske Bros. Refining Co.

549—See pages 28, 29. Cylinder Lubrication: Sinclair makes a wide variety of steam cylinder oils to handle every possible need. Consult the Sinclair representative concerning your lubrication problem. Sinclair Refining Co.

550—See page 45. Lubrication: Mail coupon on page 45 for free booklet "11 Ways to Cut Production Costs" and also information on the new Alemite Oil-Mist System. Alemite, Div. of Stewart-Warner.

551—See page 140. Non-Fluid Oil: Send for instructive bulletin and free testing sample of Non-Fluid Oil for positive bearing protection. New York & New Jersey Lubricant Co.

552—See pages 35, 36. Lubrication Service: Consult your nearest Standard Service-Supply Center for your lubrication needs. Deliveries can be made in a few hours. Also ask about Stanoil for clean, maximum performance in hydraulic units, speed reducers and circulating systems — expert, personal service by Standard Oil Lubrication specialists, too. Write for full information. Standard Oil Company (Indiana).

For your free copies of this new literature and more data on advertised products, list the key numbers of the descriptive paragraphs on one of the handy order cards on pg. 132. Mail today—postage-free!

553—See page 101. Lubricant: Send for illustrated booklet "Sunco Way Lubricant" with complete information and factual case histories. Sun Oil Co.

MATERIALS OF CONSTRUCTION

555—See page 56. "K" and "KR" Monel: Write for free 23-page reference manual "Engineering Properties of 'K' Monel and 'KR' Monel" containing essential engineering data on these alloys. International Nickel Co., Inc.

MECHANICAL POWER TRANSMISSION

556—See page 32. Belts: Write for Bulletin 6869D with complete information on Condor Whipcord Endless Belts. Raybestos-Manhattan, Inc.

557—See page 61. Multi-V-Drives: Send coupon on page 61 for Bulletin V-1400-B7F with full details on Worthington Multi-V-Drives and QD Sheaves. Worthington Pump and Machinery Corp.

558—See pages 51, 52, 53, 54. V-Belts: See advertisement for typical examples of Goodrich Grommet Belts. Last 20 to 50% longer than other types, yet

(Continued on page 128)

4 WAYS TO CUT THOSE PUMP REPAIRS

Sims valves are made in sizes from 2¾" to 15¼" to fit any reciprocating pump. Valves supplied ready to install—cast in individual units or in complete plates.

1. **Prevent STEM and SPRING breakage.** Exclusive double shock absorber built into Sims valves stops impact shock.
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3. **Keep seating surfaces leak free.** Only Sims guarantees the valve DISC will rotate every time it lifts.
4. **Stop valve slam and knock.** Quiet operation is gained by cushioning moving parts and cutting resistance to flow through the SEAT ... with patented **inclined ribs.** This reduction of resistance allows cylinders to fill completely. Pump capacity is increased 20%.

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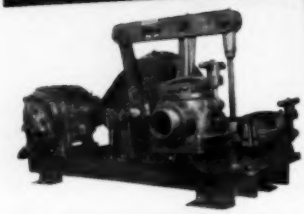

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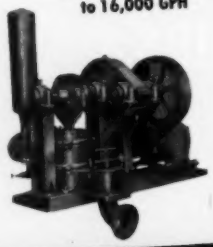

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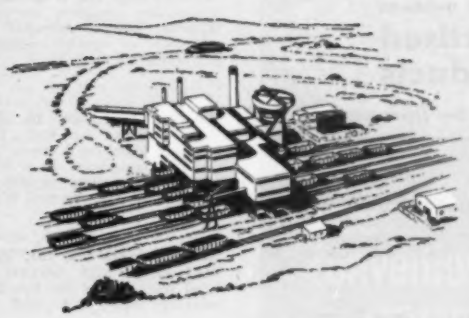

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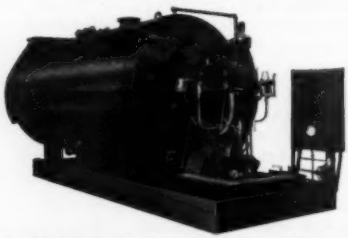

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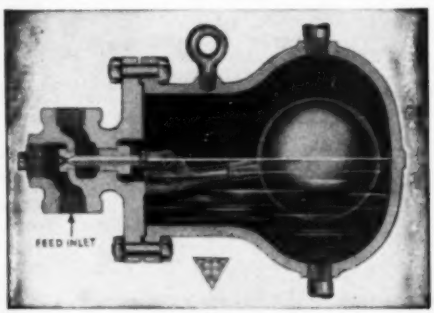

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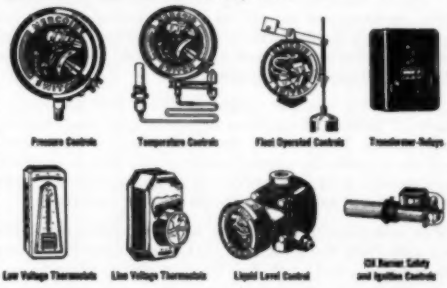

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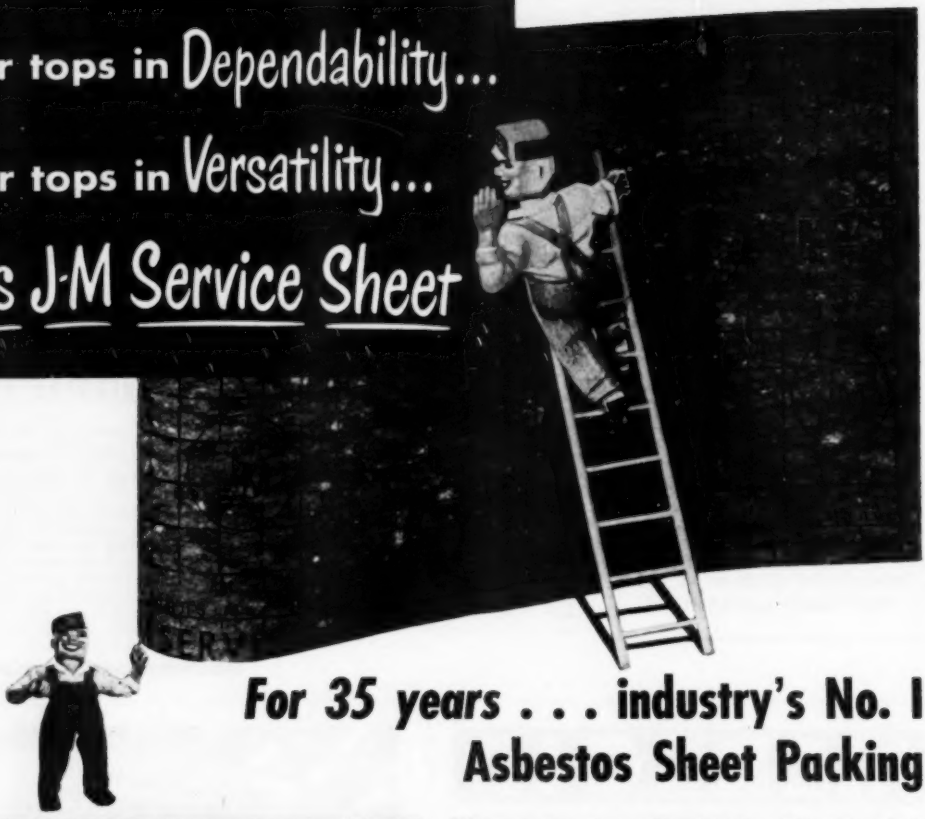

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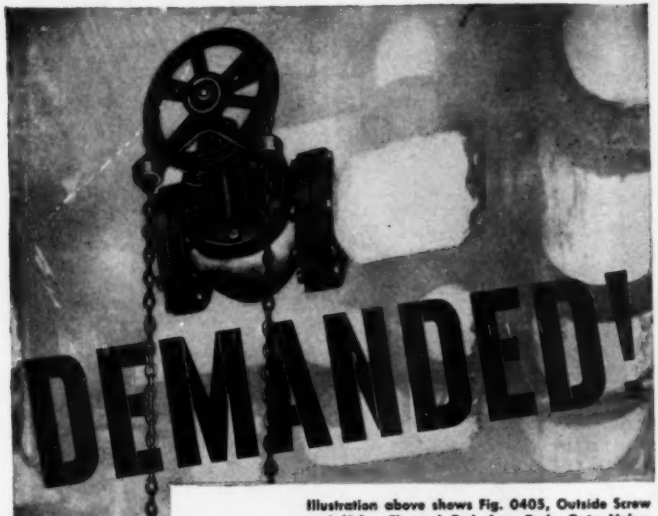

Illustration above shows Fig. 0405, Outside Screw and Yoke, Flanged End, Iron Body Gate Valve, with Adjustable Sprocket Rim with Chain Guide.

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CENTRIFUGAL PUMPS

(Continued from page 91)

provided for double-suction axially-split casing pumps in order to meet special piping arrangements as, for instance, a vertically-split casing with bottom-suction and top-discharge in one half of the casing. Such special designs are costly and should be avoided.

Inasmuch as suction and discharge locations are intimately connected with the rotation selected for a given centrifugal pump, it is very important to understand the means used to define the direction of rotation.

According to the Hydraulic Institute Standards, rotation is clockwise or counter-clockwise when looking at the driven end of a horizontal pump or down on a vertical pump. Some manufacturers still designate rotation of a horizontal pump looking at its outboard end. Therefore, to avoid misunderstanding, clockwise or counter-clockwise rotation should always be qualified by the direction from which one looks at the pump.

Inboard and outboard ends are terms used with horizontal pumps only. The inboard end is the one nearer the driver, while the outboard end is the one further away.

Casing hand holes are furnished primarily on pumps handling sewage and stringy materials, which are liable to become lodged on the suction vane edges of the impeller. They provide access for cleaning out such material without dismantling the complete pump. On the end-suction type of pump, used primarily for handling liquids of this type, hand holes with access to the suction side of the impellers are provided on the suction head or in the suction elbow. Hand holes are also provided on drainage, irrigation, circulating and supply pumps when foreign matter may become lodged in the waterways. On very large pumps manholes are often provided for cleaning and inspection.

Majority of single-stage centrifugal pumps are intended for service with moderate pressures and temperatures. As a result, general practice of pump manufacturers is to design a special line or lines of pumps intended for high operating pressures and temperatures.

When axially split casings are subjected to high pressures, there is a tendency to *breathe* at the split joint. Such a tendency leads to misalignment of the rotor and—which is even worse—to leakage. For such conditions, internal and external ribbing is applied to casings at points subjected to the greater stresses.

Modern Fuel Oils And Applications of Additives

(Continued from page 96)

rosion where such residues are involved, if so-called inert oxide type additives are put into the oil prior to combustion. Such additives are lime, iron oxide, aluminum oxide and similar types of materials. In all fairness it should be stated that this work at the present time is still in progress and the above referred to references should be consulted for more definite data.

Conclusion

As explained in this article, modern refining methods have to some extent contributed to the instability of fuel oils. In particular, they have made No. 6 fuel oil susceptible to sluge formation especially when water is in the system.

Actually most sludges consist of a water-in-oil emulsion. Owing to this situation ordinary hydrocarbon solvents are not effective in eliminating sludges since they do not mix with the emulsion. Properly compounded mixtures of solvents with surface active materials are effective as demonstrated in the paper. Furthermore, additives containing combustion catalysts are available that will appreciably improve combustion thus eliminating soot and possibly alleviating slag. For the elimination of slag and corrosion problems, special additives generally of the metallic oxide type have found the greatest application.

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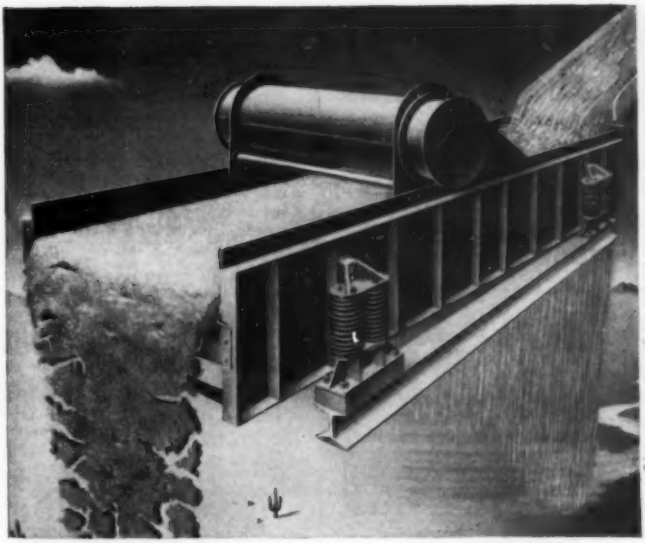

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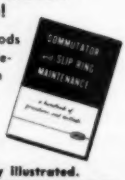

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COMPANY_____

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CITY_____ ZONE____ STATE____

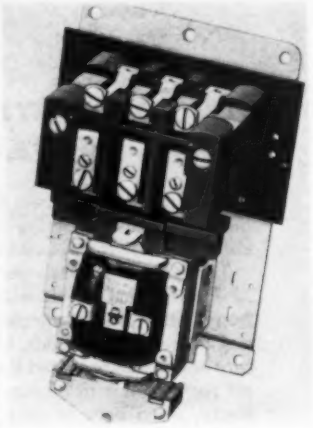
New equipment and developments

(Continued from page 22)

and the valve can be mounted in any position. In the double solenoid unit, the spool is automatically pressure-centered when the solenoids are de-energized.

26—CONTACTOR IS SOLENOID OPERATED

Ward Leonard Electric Co. announces the development of size 0 a-c solenoid contactors. These multi-pole contactors are designed for both load and control circuit use in controllers for machine tools, refrigeration and air conditioning equipment and similar control applications. Important features include multi-pole unit construc-



tion, double break silver contacts easily converted to N. O. or N. C. contacts, a-c or d-c power plants, solenoid operated and complete accessibility of parts. Contactors are available in 3 and 5 pole forms and can be furnished with d-c power plants for 115 or 230 v d-c operation. Standard coils are available for 110, 220, 440 and 550 v operation on 25, 50 or 60 cycles.

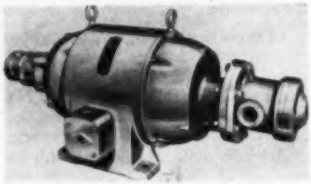
27—CARBIDE TIPPED MASONRY DRILL

"Speed Spiral" is the name given an interesting carbide tipped masonry drill designed and being marketed by the Super Tool Co. This drill is machined from the solid with a round nose supporting the carbide tip. The design provides ample dust clearance without necessitating gashing ahead of the carbide tip or otherwise weakening the end that does the work. It also reduces the chance of cracked or weakened tips due to brazing strains. Double lead

fast spiral dust grooves are made extra deep for long life. They pick up the dust from immediately behind the carbide tip and are completely efficient because the dust load can automatically distribute itself, there being no interference with free entry of dust cut by either edge of the tip into either or both grooves.

28—MOTOR HAS FLANGE PUMP MOUNTING

The Reuland Electric Co. has announced a hydraulic pump motor featuring a system of direct mounting between pump and motor. The system has been standardized and is adaptable to all makes of pumps. Primary



benefit derived is the automatic insuring of precision alignment in every installation. All motors are supplied with machined endbell flanges, pre-engineered to fit the registers on the pump mounting flange. Installation is simplified by merely bolting the two flanges together, and overall dimensions are reduced. Motors can be supplied with pump flange mount on one or both endbells in all standard ratings of horsepower and speed.

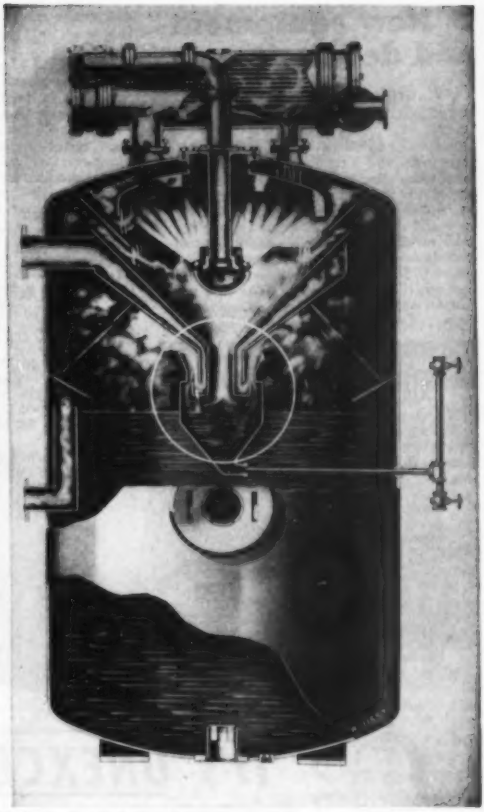
Additional information on new equipment and development items is available. Use card inserted between pages 132 & 133

29—TRANSFORMER DESIGN CONSERVES MATERIAL

General-purpose, dry-type transformers featuring Class B insulation have been announced by General Electric's Specialty Transformer and Ballast Div. for single-

phase, 60 cycle operation. This design provides smaller transformers at an average weight reduction of 30 per cent throughout the line. These size and weight advantages are obtained through the use of improved

(Continued on page 138)



Hard scale, formed on the trays of deaerating evaporator preheaters, is no longer the big problem it used to be.

In a large central station (name on request), the preheaters had to be cleaned every three weeks, and the units were completely shut down at that time from eight to ten hours.

Then Worthington steam-jet deaerators were installed—with a "blowdown" head designed by Worthington engineers. This special head allows the operator to remove harmful deposits at regular intervals *while the unit continues in service*. It also provides for simple and speedy acid cleaning of critical parts, when necessary, without even opening an access door or removing any parts from the unit.

Compare The "Time-Outs"

The Worthington unit, given a short blowdown once each shift, stays in continuous operation with maximum deaeration for periods of at least 8 months. When the acid treatment is given at the end of that period, the job is finished in under three hours.

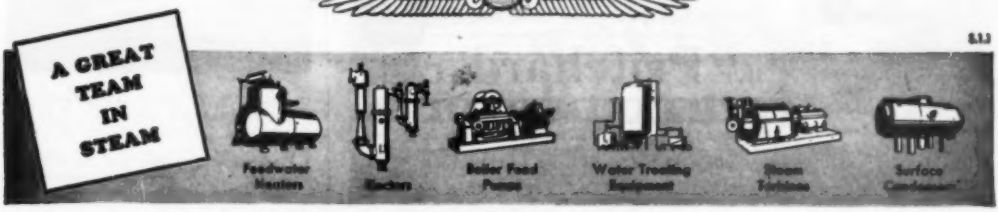
Compare this with the former record. *Then*—8 to 10 hours outage every three weeks and labor by a *crew* of men. Now—with Worthington's blowdown head—operation uninterrupted during regular short blowdown, with a shutdown for acid cleaning only once in almost a year, requiring only one man and three hours!

Worthington Makes Deaerating Equipment News

Developments like this, applicable to any deaerators operating under conditions of scaling, are typical of Worthington's engineering firsts in water treating and deaerating equipment.

Worthington manufactures all of the equipment needed in a complete water treating installation. For further information on why *there's more worth in Worthington*, address Worthington Pump and Machinery Corporation, Steam Power Div., Harrison, N. J.

WORTHINGTON



New equipment and developments

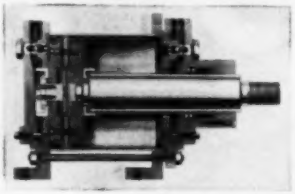
(Continued from page 136)

core steels and increased amounts of inorganic insulating materials. The insulation withstands higher temperatures in the copper windings—80 C rise over a 40 C ambient—and the corisil core (a grain-oriented, cold rolled silicon steel) provides comparable losses at higher flux densities, it is claimed. Several ratings are available now and others are being added. The line ultimately will consist of about 50 models in ratings of 3 kva and upwards.

30—CYLINDERS OPERATED BY AIR, OIL OR WATER

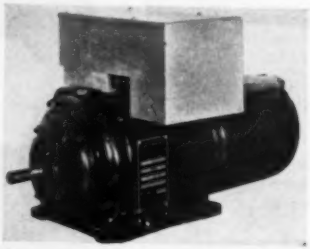
A complete line of low-pressure cylinders manufactured by Hanna Engineering Works for operation by air, oil or water incorporates newest design and construction features. Among the features are: a cork floater ring, which facilitates cushion alignment with the head and insures a seal during cushioning; spring-backed chevron rod packings, which are self-adjusting for consistently correct compression; and flange design, which permits removal of the front head without disturbing the mounting.

These cylinders are designed for operation up to 110 psi and, with minor modifications, for higher pressures depending on cylinder diameter and operating medium. Standard models permit the selection of a cylinder to meet most any mounting requirement.



31—REMOTE SWITCH CONTROLS SPEED

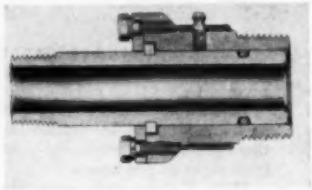
Graham Transmissions, Inc., announces a packaged system of remote electrical control for its line of infinitely variable speed transmissions in sizes from 1/12 to 5 hp. This control provides hairline accuracy of speed setting over a complete range from the maximum speed desired to zero. Easily added to the standard control of drives already in the field, the control is available for push button operation at the remote point and can be had with or without remote speed indication. Control is available on all models of their variable speed transmissions.



Additional information on new equipment and development items is available. Use card inserted between pages 132 & 133

32—SWING JOINTS FOR PETROLEUM

Development of swing joints, which are particularly applicable to gasoline and oil tank or truck loading and unloading lines, is announced by Barco Mfg. Co. The design provides for 360 deg rotation with a long bearing surface to support the weight of normal piping. When used in pairs, connected by 90 deg ell, they provide for up-and-down and side-to-side action such as may be desired for loading and unloading lines.



Sizes available range from 3/8 to 3 in. for threaded connections and from 4 to 12 in. with flanged connections. Sealing is by means of an "O" ring confined in a recess in the sleeve of the joint. Special rings are provided for handling gasoline, fuel oil and other liquids without softening, swelling or deterioration at pressures from 0 to 100 psi, or to as high as 500 psi in smaller units. Suitable for temperatures between —40 to 225 F.

33—VOLUME CONTROL PERMITS COMBINATIONS

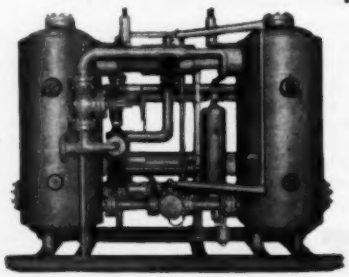
The flexibility of choosing the desired combination of control, switch and shaft, heretofore available with the larger or 1-1/8

in. dia volume control replacements, is now extended to the smaller. 15/16 in. dia. size as well, according to Clarostat Mfg. Co.

Formerly unavailable, the Ad-A-Switch attachable with Underwriters' approval is now being stocked by Clarostat jobbers.

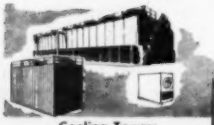
It's UNEXCELLED
FOR DEPENDABLE DEHYDRATION!

The Quality Pritchard
HYDRYER*



The Quality Pritchard HYDRYER* is *unexcelled* for dependable dehydration of air and other gases for instrument and process controls. Dual adsorbers provide continuous drying action. HYDRYER* is standard, packaged unit designed to reduce dew points to minus (—) 40°F. Only service connections are required. Specially designed HYDRYER* units can be tailored to meet your individual requirements.

*Registered Trade Name



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The series SWB or 15/16 in. Ad-A-Switch is obtainable in S.P.S.T., three-way no "Off" position S.P.D.T., and D.P.S.T.

34—VERTICAL MOTORS OPERATE PUMPS

Vertical, solid-shaft capacitor motors in ratings from ¾ to 5 hp, featuring standardized mounting dimensions and quiet operation, have been announced by General Electric's Small and Medium Motor Div. Normally furnished as part of the complete pumps, they are suitable for outdoor operation where severe climatic conditions are not encountered.

Tri-Clad construction provides the motors with protection from physical damage, electrical breakdown and operating wear and tear. Dimensions of the Type P base, machined to NEMA standards, are the same as those of polyphase motors of the same size. As accessory equipment for use with the new motors in ratings of 2 hp and less, an automatic thermal protective device is available.

35—DI-PHASE SOLVENT PROMOTES SAFETY

Announcement is made by the Curran Corp. of a synergistic solvent possessing high grease cleaning and carbon removing properties for the purpose of cleaning carburetors, fuel pumps, diesel injectors, pistons, oil strainers and metal parts. The product is described as a di-phase solvent and comprises a water emulsion floating top layer sealing a volatile chlor-aromatic solvent lower layer. High synergism is said to result from the combined action of the detergency of the two layers against water soluble and oil soluble dirt respectively. Safety to personnel results since its top water-emulsion seal prevents direct contact with skin. The solvent is also said to be fireproofed by reason of this top seal.

36—TIME DELAY RELAY USES SILICONES

A low cost time delay relay utilizing a hydraulic-magnetic operating principle has been announced by the Heingmann Electric Co. Known as the Silic-O-Netic time delay relay, it has only one moving part in the time element, which is hermetically sealed and never needs attention. The overall dimensions of the entire relay are only 1-5/8 x 2-½ x ¾ in. yet it has a rated capacity of 10 amp at 120 v a-c and is available with timings up to four minutes.

(Continued on page 140)

WESTON *Readable* ALL-METAL THERMOMETERS

—AVAILABLE IN THESE 3 TYPES

STANDARD INDUSTRIAL THERMOMETERS

All-metal dial types with stainless steel stems, in straight and angle forms. Scale lengths 3"—6" and 9", with stems from 2½" to 72". Available as testing thermometers, and for general purpose and heavy duty service. Ranges from −100 to +1000°F. All-metal construction prevents breakage, assures dependable accuracy for longer periods.

CONTACT MAKING THERMOMETERS

Combines the features of the all-metal indicating thermometer with an alarm or control device. Has adjustable contact arm mounted in the glass and bezel. Supplied to make contact on increasing or decreasing temperatures. Has positive magnetic type contacts. Contact rating . . . 100 ma at 110 volts a-c; 50 ma at 110 volts d-c. Stem lengths 2½" to 24".

MAX-MIN® THERMOMETERS

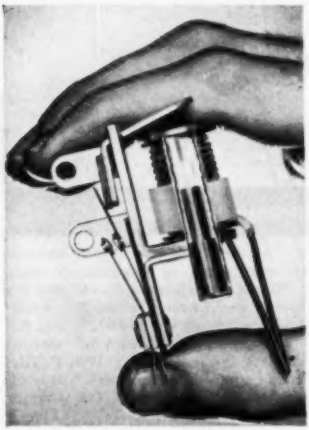
Equipped with a manually set red index which moves up or down scale with pointer, remaining at extreme temperature reached until reset. Thus one reading gives present temperature, and maximum or minimum reached since last reading. Available in scale lengths of 6" and 9"—stem lengths 2½" to 24".

Literature describing Weston all-metal, as well as electrical and glass thermometers, sent on request. WESTON Electrical Instrument Corporation, 605 Frelinghuysen Avenue, Newark 5, New Jersey . . . manufacturers of Weston and TAGliabue instruments.

WESTON *Instruments*

New equipment and developments

(Continued from page 139)

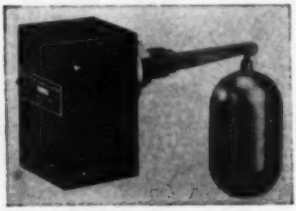


The operating principle utilized is new in the field of relays. Instead of the fixed solid core of conventional relays, it has a sealed tube extending through and below the relay coil. The tube is filled with a viscosity-stable silicone liquid and holds a movable iron core. When the coil is energized, the movable core is drawn up into the magnetic field, but the rate of rise is controlled by the silicone liquid, introducing a precise time delay. The relay operates on the increased magnetic flux caused as the core reaches the pole piece at the top of the tube.

Additional information on new equipment and development items is available. Use card inserted between pages 132 & 133

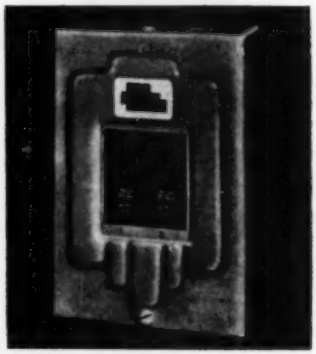
37—SWITCH WORKS ALARM OR CUTS OFF FUEL

A float-operated signal switch device or fuel cut-off designed to operate on pressures from vacuum to 450 psi is announced by Reliance Gauge Column Co. This unit, designated as Levalarm EA-10, is heavier and embodies improved construction features. As a signal switch it is used to set off warning signals when liquids in small boilers or various types of tanks reach predetermined low or high points, or it can be used as a fuel cut-off for low water. In conjunction with water columns the float lever is inserted into the alarm valve opening.



38—LOAD CENTER CARRIES FULL RATED LOAD

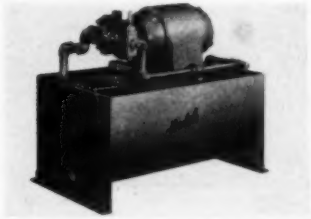
A two circuit load center that will continuously carry 100 per cent of its full rated load has been announced by Murray Mfg. Corp. It has a rated 55 amp main with a capacity of two 50 amp, single pole, 120 v a-c fully magnetic circuit breakers. Fully magnetic action differs from the action of all thermal devices in that its rated operation does not change with changes in temperature. This load center can be installed as a main disconnect in place of a comparable 60 amp fused switch. It has specific application as a service entrance and main disconnect switch and for single phase lighting and appliance circuits.



39—HYDRAULIC POWER UNITS COMPACT

A complete line of hydraulic power units, combining reservoir, pump and motor into a compact unit is now being produced by Haskel Engineering and Supply Co. 224 standard models are manufactured in three basic standard series: low-pressure units in single and double pump models, which supply up to 1750 psi pressure and range from 1-1/2 to 100 gpm; Hi-Low units, which provide a dual pressure source by combining a high pressure and low pressure pump with automatic unloading of the low pressure pump, which feature re-

(Continued on page 142)



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Constant oil and grease leakage from overhead crane motors not only results in high lubricant and application costs, but also stock cleaning costs are increased when oil deposits must be removed. In fact, on sheet metal products, it is virtually impossible to remove these spots in the pickling process or even when the sheets are annealed.

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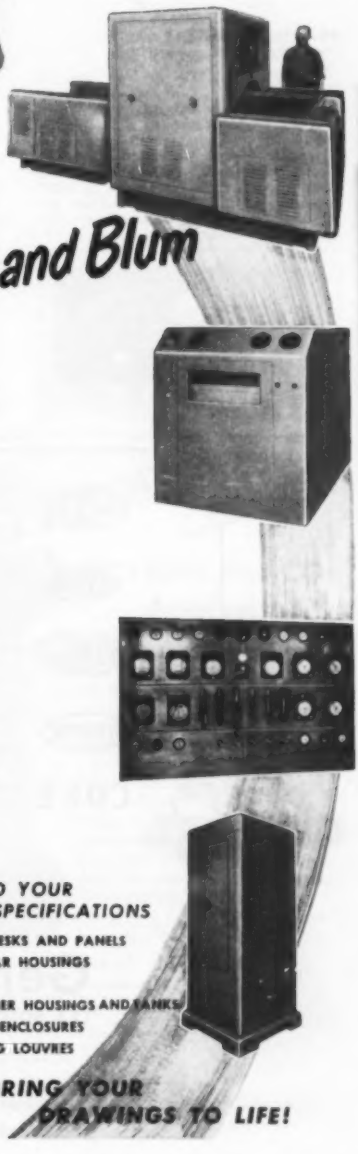

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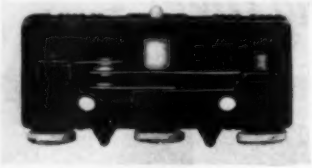
New equipment and developments

(Continued from page 140)

duces the power requirement by one-half over a non-unloading system; and Hi-Pressure units supplying up to 10,000 psi pressure and ranging from 1-½ to 5 gpm in single pump models and to 10 gpm in double pump models.

40—LIMIT SWITCH HAS LONG LIFE

General Control Co. has developed the du.op switch for use in the numerous applications requiring a compact, light-weight, long-life limit switch. As a direct-acting switch, the du.op has no inherent characteristics of bounce. Mechanical lost motion is eliminated because instantaneous contact is made at the same fixed point of repetitive plunger travel. Plunger location permits easy cam design, and plunger direct action insures constant contact pressure. The contact arrangement is single pole, double throw, spring return, and will handle up to 20 amp, 125 v a-c, non-inductive. The switch is enclosed in a phenolic-molded housing with 1 in. mounting.



41—TIMING MOTOR USES 400 CYCLE A-C

A 400 cycle timing motor has been developed by the Haydon Mfg. Co., Inc., for use as time standard in applications involving relatively light loads. This new 400 cycle motor is an hysteresis type synchronous timing motor and is designed for use either as a separate component or in a variety of types of standard timers. They are designed specifically for timing applications where 400 cycle current is or can be made available. Variations in temperature, supply voltage and load, within the operational limits of the motor, do not affect timing. Since the motors follow frequency changes, with normal frequency control, comparatively close timing tolerances can be held.

42—MASKING SIMPLIFIED BY PRE-CUT FORMS

Method of masking products during various stages of production has been developed by the W. H. Brady Co. Known as Quik-Masks, these self-adhesive, pre-cut masks and gaskets are quickly applied without moistening to the areas requiring protection. They provide protection during spray painting, cleaning, plating, machining, tumbling, sandblasting, buffing and many other operations. Made from pressure-sensitive masking tapes they come pre-cut to the exact size and shape required and are either mounted several masks to a card or individually. Standard shapes are available or special designs can be made to exact requirements.

43—BOILERS COMPLETE MANUFACTURERS LINE

To meet industry's demand for lower pressure boilers in the 1½ hp capacity range, Livingstone Engineering Co., announces two Speedylectric models LP-1½ and 400-1½. The addition of these models completes the line making available a 1½ hp Speedylectric boiler model LP (maximum pressure 15 psi) and the model 400 (maximum pressure 50 psi). Available for 220, 440 and 550 v, single phase power, this boiler series is compact, 14 in. wide, 22 in.

RODA — High grade gas, by-product, steam and household stoker coal from Wise County, Virginia, on the Interstate Railroad.

DENDRON — High grade gas, by-product, steam and domestic coal from Wise County, Va., on the Interstate Railroad.

STONEGA — High grade, high volatile steam and by-product coal from Wise County, Va., on the Interstate Railroad.

GLENBROOK — The Premium Kentucky High Splint unmatched for domestic use. Produced in Harlan County, Kentucky, on the L. & N. Railroad.

COKE — Roda and Stonega from Wise County, Va.

CRITERION COAL — High grade gas, by-product, steam and domestic coal—Pittsburgh seam from Irwin Basin, Westmoreland County, Pennsylvania, on the Penna. Railroad.

HAMPTON COAL — High volatile domestic, steam and by-product coal from Boone and Logan Counties, W. Va., on the Chesapeake & Ohio Ry.

CROZER — Genuine Pocahontas from McDowell County, W. Va., on the Norfolk & Western Railway.

LYNCO — High fusion coking coal for by-product, industrial stoker and pulverizer use from Wyoming Co., W. Va., on the Virginian Ry.

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Hazle Brook—*Premium Lehigh*
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long, 28 in. high and requires 15 kw power input for maximum steam output. On 220 v single phase, 68 amp are required to deliver 45 lb of steam per hr. Like all Speedylectric boilers there are no coils to burn out, no tubes to scale, no open flame of fire hazzard and no low water danger. Heat is generated by the resistance of the boiler water to the flow of current between solid metal electrodes—if there is no water in the boiler no current will flow, and power input stops. Model LP 1½ is designed for low pressure applications under 12 psi. Model 400-1½ is for pressures up to 50 psi. Both carry Underwriters' Laboratories listing.

Additional information on new equipment and development items is available. Use card inserted between pages 132 & 133

44—DEVICE MADE FOR BETTER CONTROL

An instrument that provides sensitive, instantaneous and accurate control of flow, temperature, pressure, liquid level and other industrial process variables has been developed by Minneapolis-Honeywell Regulator Co. The device, the Tel-O-Set controller, is described as the latest component in a series of new designs to improve process control. The other components of the group are the differential converter, Tel-O-Set indicator and Tel-O-Set recorder. This controller was developed for use with the other three components. It is further described as a low-cost, easily installed, compact unit, which provides maximum trouble-free operation. In addition to extreme sensitivity and rapid response to process change, the controller operates on a pneumatic balance principle, which eliminates friction and lost motion.

Made in two types, one with fixed proportional band, the other with adjustable proportional band. The units are constructed of a number of coded, interchangeable sections separated by diaphragms. Except for manual adjustments of reset on the band unit, the Tel-O-Set controllers operate wholly in response to pneumatic signals.

45—HEAVY DUTY OIL MEETS ARMY SPEC.

A series of heavy duty engine oils, Ursa Oil X Sup. One 10, 20, 30, 40 and 50, has been marketed by the Texas Co. for the lubrication of heavy duty gasoline and automotive-type diesel engines that are operated under adverse conditions. The new Texaco series was developed by the company's research laboratories to provide a heavy duty lubricant for application wherever an oil meeting the requirements of U. S. Army Specification 2-104B, Supplemental List No. 1, is desired.

Laboratory and field tests revealed that this new lubricant provides the extra protection now required in severe but unsupercharged heavy duty engine service. It delivers satisfactory protection in service employing diesel fuels up to 1.0 per cent, or higher, sulfur content.

46—VOLTAGE REGULATORS SERVE WIDE FIELD

A redesigned line of single-phase Inductrols in standard ratings of 9.6 to 24 kva has been announced by the General Electric Company's Transformer and Allied Product Div. These new dry-type induction voltage regulator units are available for single-phase circuits, 600 v and below up to 1000 amp.

With standard controls, the single-phase Inductrols can be used for secondary circuit regulation where lighting and power are

(Continued on page 144)

Pipe joints sealed with Key-Tite cannot leak. Key-Tite is a perfect seal on all lines carrying water, gas, low-pressure steam, compressed air, etc. It contains no lead or substitutes and does not affect the taste or odor of potable liquids. Joints are easily opened, too, for it will not freeze in the joint. Stop losing money through leaky pipe joints...seal with Key-Tite.

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KEY Company

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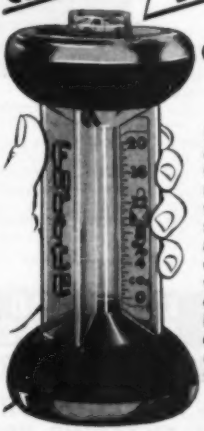
321 S. 27th St., East St. Louis, Ill.

CONVENIENT LOW COST ACCURATE



OXYGEN and CO_2 Analysis

FYRITE Gas Analyzer shown at the left is available in two models—one for direct CO_2 analysis, the other for direct oxygen analysis. Both instruments employ the volumetric method of gas analysis involving selective absorption of CO_2 or oxygen by a chemical absorbent. A complete analysis can be made in 40 seconds. Accuracy is within one-half of one per cent CO_2 or oxygen. Absorbing fluids are furnished in individually bottled refills, and replacement of the fluid in the instrument merely requires removing the four screws that hold the cap assembly in place.

Write for Leaflet I-700

Available Individually or As A Set

FYRITE Gas Analyzers can be supplied individually—in a metal instrument chest complete with rubber aspirator, rubber and metal sampling tubing and filter, as shown at the right; or in a "Duplex Kit" which comprises both CO_2 and Oxygen Analyzers together with one complete gas sampling assembly for connecting either instrument to the desired sampling point.

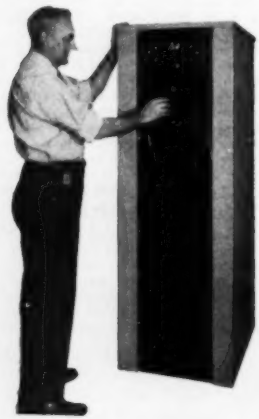
BACHARACH Industrial Instrument Company
7000 Bennett Street • Pittsburgh 8, Pa.

New equipment and developments

(Continued from page 43)

supplied from the same lines, for controlling voltage in instruments, operating resistance and induction furnaces.

Basically, the unit consists of a shunt winding located on the rotor and a series winding located on the stator. Varying the



position of the rotor with respect to the stator causes a variation of voltage in the series winding that will raise or lower the output voltage gradually, as required by changes in load. The equipment is housed in an all-steel cabinet.

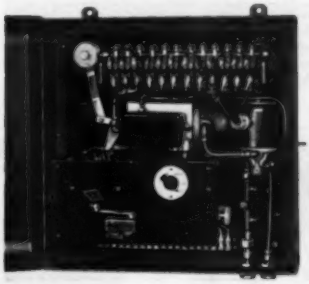
47—HIGH PRESSURE STEAM JET CLEANER

Making available to industry the latest developments in steam-detergent cleaning for plant maintenance and industrial housekeeping, Livingstone Engineering Co. announces the Speedylectric steam-jet cleaner model JC-25. This unit is built to operate at pressures up to 200 psi. The combination of high pressure and a twin-jet steam lance, with finger-tip control, gives super-jet velocity and powerful cleaning action. Only 16 in. wide and 48 in. long, the JC-25 is designed for maximum portability in close quarters. The unit is completely self-contained with space provided on the all-steel truck to mount a water tank of sufficient capacity for 3 to 4 hr of continuous operation. The boiler is the Speedylectric model 600-S3 built under ASME Code, carries National Board stamp, and is Underwriters' Laboratories listed. Available for 220, 440 or 550 v. Rated at 20 kw, the JC-25 under ordinary operating conditions consumes 15 kwh.

Additional information on new equipment and development items is available. Use card inserted between pages 132 & 133

48—STEP CONTROLLERS FOR COMPRESSORS

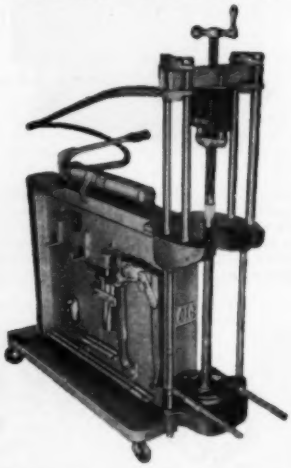
A pneumatic step controller has been developed by the Johnson Service Co., that may be applied to many sequence control problems. It is designed especially for controlling multiple stages of refrigeration capacity. Control is accomplished by starting and stopping compressors in sequence, loading and unloading cylinders or a combination of both. The unit is available in 4, 6, 8 or 12-switch models. Each of the



single-pole, double-throw switches is operated by a pair of cams on a shaft, which is rotated by a pneumatic piston in response to a pneumatic temperature or pressure measuring instrument. *On* and *off* points of each switch are individually adjustable over the entire range of operation. Several different springs are available for the piston to provide a selection of ranges, or the piston may be provided with a pilot positioner, which permits adjustment of the operation range. This controller is provided with a current failure solenoid, which exhausts air from the piston, returning all switches to their normal position whenever current is interrupted. An adjustable time delay, providing up to 12 min for a complete piston stroke, assures sequence starting, regardless of the demands of the controller, when power is restored.

49—PORTABLE UNIT GOES TO THE JOB

Owatonna Tool Co., announces a portable Hydra-Tote that takes pulling tools to the job in place of hauling the job to the tools. This unit contains the complete OTC hydraulic pulling system, is easily moved to any spot in the shop. Welded steel construction, 32 in. high, 36½ in. long, 16 in. wide at the base and 4 in. wide at the top, there is 10½ in. of clearance between the press



uprights, 11 in. clearance from the ram to top of the press plate and 34 in. from press plate to floor. Unlimited vertical adjustment is possible with interchangeable legs in the upper press frame and three easy adjustments in the lower press frame. The assembly is equipped with 3 in. rubber casters for easy mobility. The hydraulic press has a capacity of 17½ ton.

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"AND WE THOUGHT WE DIDN'T HAVE ANY SCRAP!"

"We don't make anything of steel . . . so we didn't think we were concerned in the national scrap program.

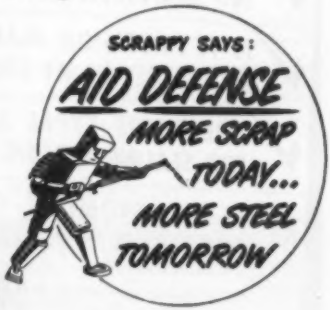
"Then we came to realize how badly *we* would be affected if steel products we *use* were shut off by the shortage of scrap.

"When we learned a *photographic film* manufacturer was able to collect 88 *carloads* of iron and steel scrap in his own plant—we began looking.

"We found plenty of idle metal that had rust on it and dust on it. Obsolete machinery. Outmoded equipment, jigs and fixtures. Broken parts—like wheels, chain, springs. Abandoned structures made of steel.

"We found plenty. And, knowing our best chance of *getting steel products* was by furnishing the raw materials for steel-making, we promptly called in our local scrap dealer.

"I'd urge *any* business to look over its premises with an eye out for scrap. Non-ferrous scrap is needed, too! Why don't *you* appoint one man—with authority—to act as *your* Scrap Salvage Director?"



This advertisement is a contribution, in the national interest, by

INDUSTRY AND POWER

A PUBLIC SERVICE PROGRAM OF THE ADVERTISING COUNCIL

New bulletins and catalogs

(Continued from page 33)

tric power equipment for quick expansion with a minimum of critical materials. 52 photographs and diagrams explain the result of using "packaged" electrical systems. Said to eliminate the need for individually engineered assembly of piecemeal components. Also offers a list of 31 other G-E bulletins giving full information on available equipment for industrial power expansion. General Electric Co.

INSTRUMENTS, CONTROLS, RECORDERS

229—Combustion & Industrial Instruments & Controllers. Complete line of instruments and controllers for both boiler rooms and industrial processes is covered briefly in 12-page condensed catalog 687. Refers to detailed catalogs for specific items. Contains photographs illustrating the equipment and schematic drawings showing how the units are applied. The Hays Corp.

230—Electrical Measuring Instruments. Information on "how to select" electrical measuring instruments is provided in 30-page booklet B4696. Seven basic selection factors are explained; types of instruments are listed; and, four typical selection problems are solved. Complete lines of portable, switchboard, panel, recording, and socket instruments are described and illustrated, and functions of each are explained. Descriptions of instrument auxiliaries are included. Westinghouse Electric Corp.

231—Furnace Draft Control. Automatic sequence furnace draft controller for on and off type firing equipment is illustrated and described in 8-page bulletin 51-489. Detailed discussions cover types for oil and gas burners, and stokers. On-the-job photographs illustrate case histories showing savings accomplished. The Hays Corp.

232—Rotary Condensate Meters. Bulletin R-513 explains design, construction, installation and operation of rotary condensate meter, said to be an economical means of determining steam consumption where all the condensate can be captured. The 4-page bulletin includes size, dimension and weight tables, and simplified piping diagrams for both gravity and vacuum systems. Illustrated with photos of typical installations, cutaway drawings of rotor operation and sketches of features. American District Steam Co., Inc.

233—Combustion Control System. Eight-page case history (bulletin R6) tells of boiler room modernization and expansion. New equipment added, building changes, uses for steam and boiler conditions are described and illustrated. In addition text, photographs and schematic diagrams trace operation of the combustion control system. Results obtained with new equipment are listed. The Hays Corp.

234—Mercury Switches. Condensed catalog HG-1 on line of mercury switches covers five most popular designs along with selection and application aids, and complete electrical ratings and data for use of these switches in both a-c and d-c applications. Micro Switch Div., Minneapolis-Honeywell Regulator Co.

235—Frequency Recorder. Two-page data sheet 9.1-8 describes frequency recorder designed for measuring and recording the frequency of electrical power production. Complete engineering specifications and operating characteristics including circuit diagrams and illustrations of the instrument are included. Brown Instruments Div., Minneapolis-Honeywell Regulator Co.

Bulletins and catalogs reviewed here are yours for the asking. Use card inserted between pages 132 & 133

236—Tensiometer. Bulletin GEA5512 describes the tensiometer, a device for continuous tension indication of cold-rolled strip. Illustrated with photographs and diagrams, the 8-page bulletin describes the mechanical and electrical operation of the unit, its possible applications, and recommended auxiliary equipment. General Electric Co.

237—Pressure, Temperature Regulators. Bulletin 751 illustrates and describes pressure regulators, temperature regulators and combination pressure and temperature regulators. It includes dimensions, application, capacity, engineering tables and specifications. O. C. Keckley Co.

238—Differential Converter. Mercuryless flow meter, said to feature fast speed of response for flow control and continuous range change adjustment from 0-20 to 0-200 in. of water, is described in 16-page catalog 2281. Operating principles of pneumatic-balance type flow transmitter are covered, as well as construction features, typical applications and detailed specifications, together with installation methods. Industrial Div., Minneapolis-Honeywell Regulator Co.,

239—Industrial Electronic Tubes. Designed for industrial use, 28-page booklet furnishes complete technical specifications and information on hundreds of special purpose electronic tubes used in such various industrial applications as control, processing, counting, sorting, weighing, measuring, detecting, and communications. Please write direct, mentioning this publication, to Milo Radio & Electronics Corp., 200 Greenwich St., New York 7, N. Y.

240—Oxygen Recorder. Magno-Therm oxygen recorder is fully described in

(Continued on page 148)

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✓ IS IT LUBRICATED THRUOUT - AND WEARS LIKE A BEARING ?	*Yes*
✓ WILL IT OPERATE WITHOUT SCORING SHAFTS, SLEEVES OR STEMS ?	*Yes*
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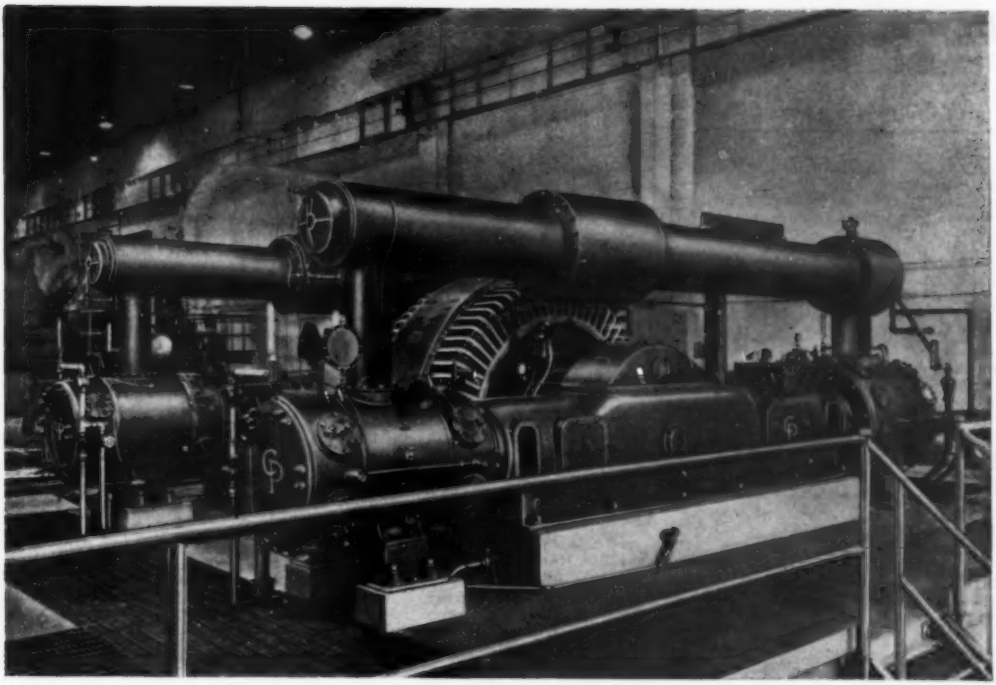
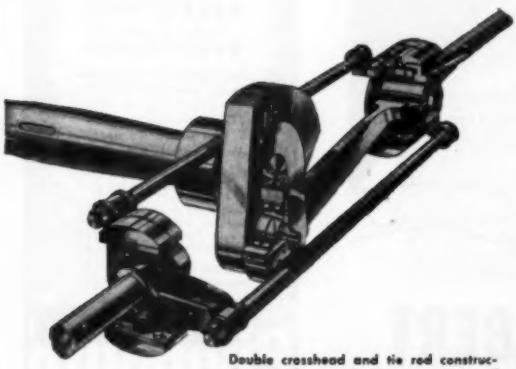
Prove this to yourself on your own equipment. Write for information on special types and styles of Durametallic Packings for your sealing needs. Ask for Bulletin No. DMIP. Durametallic Corporation, Kalamazoo, Michigan.



CP FOUR-CORNER motor-driven compressors

6,000 to 12,000 cfm piston displacement at 100 lbs. pressure



Double crosshead and tie rod construction provides straight-line transmission of power — with only one connecting rod. Roller bearings and crank discs are mounted by the oil injection method.

Class H-CE Duplex Synchronous Motor-Driven Compressors have anti-friction roller bearings throughout: spherical roller main and crankpin bearings . . . heavy-duty needle bearings at crosshead pins.

The use of roller bearings in the running gear, and the oil injection system of bearing installation and removal, eliminate all danger of misadjustment in maintenance, and permits the use of one-piece crank disc and solid-end connecting rods — the strongest and safest type.

Write for Bulletin 726-C

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PNEUMATIC TOOLS • AIR COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES
ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES

New bulletins and catalogs

(Continued from page 146)

16-page illustrated bulletin 51-829. Includes application table showing where, how and why the instrument is used; complete explanation of how an analysis is made; detail photos and discussion of features; operation of various gas sampling systems used with the instrument; and chart-illustrated discussions of results obtained with the O_2 recorder in several installations. The Hays Corp.

241—Combustion Controls. Information on full line of combustion controls is contained in 12-page bulletin C512H. Lists features of each unit and suggests applications. Photographs show component parts, while sketches give dimensions. Drawings of typical installations show how the units work. Specifications are included along with discussion on what combustion instruments and controls should be specified. Cleveland Fuel Equipment Co.

242—Temperature Regulator. Bulletin 316 describes and illustrates regulator said to provide accurate control over liquid or air temperatures in wide variety of industrial applications. Features of construction and operation are discussed. Diagrams show typical applications as well as available accessories. Two types of diaphragm valves for control applications also are pictured and described. The Powers Regulator Co.

243—Utility Tester. Data sheet gives information on instrument for testing all electrical circuits and utilities as well as all motors to 2 hp. Explains just what the unit will do to help solve testing problems. Superior Electronic Co.

244—Regulators & Controllers. How to solve your pressure and temperature control problems by using selection charts is explained in 4-page bulletin 502. Gives advantages and features on line of regulators for regulation and control of pressure, temperature and liquid level. Includes photographs and cutaway views. Leslie Co.

245—Industrial Strain Gages. Four ways in which these weighing units are being used for industrial weighing are briefly described in 4-page bulletin. Applications include continuous weight integrator for materials carried by belt, crane hooks, multi-tank weighing and batch control of liquids. Baldwin-Lima-Hamilton Corp.

BULK HANDLING EQUIPMENT

246—Pivoted Bucket Carriers. Bulletin HB551 describes features of pivoted bucket carrier, designed for moving wet or dry bulk materials. The design includes a continuous series of buckets, suspended between two endless chains, says the 4-page bulletin. Illustrations show some examples of typical circuits, which may follow horizontal, vertical or inclined paths. Hapman Conveyors, Inc., div of Hapman-Dutton Co.

247—Feeders & Conveyers. Catalog 830, 84 pages, tells the whole story of electric vibrating feeders and conveyers for handling and controlling the flow of solid materials. Gives detailed description of basic design and operating principles as well as specific technical information concerning standard and special applications. Numerous photographs, sketches, diagrams and tables show standard designs, sizes, capacities and applications. Of particular interest is table of densities of typical solid materials as they occur in material handling. The Jeffrey Mfg. Co.

248—Conveyer Belt Accessories. Spring type multiple-blade belt cleaner and roller type holdback are illustrated and described in 4-page bulletin 651. Drawings show typical mounting arrangements and photographs portray typical installations. Stephens-Adamson Mfg. Co.

249—Pulverizers & Dust Collectors. Series of bulletins, including 50-page brochure, should aid in solving grinding and collecting problems. Units for fine and ultra-fine grinding along with collectors are pictured and described. Diagrams show 19 different installation arrangements. Offers data on screens & hammers, materials of construction,

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dimensions, motors, how it operates and recommended applications. Lists materials to which the units are applicable. Pulverizing Machinery Co.

250—Ash & Flyash Handling. Both hydraulic and pneumatic ash and flyash handling systems are covered detailedly in booklet. Compiled in question and answer form, it discusses the elements and advantages of various systems, and disposal schemes, such as pumping to fill area, or pumping to storage sump or dewatering bin for truck removal. Schematic drawings of arrangements under specific conditions, also diagrams of basic arrangements, are included. Beaumont Birch Co.

251—Conveyer Idlers & Machinery. Bulletin 51-81 contains information on latest designs and developments of this equipment. Includes two pages of general engineering information to help in designing and specifying belt idler equipment. Data on lubrication material and techniques are included. Also includes detailed description of zipper bunker seals plus data on belt conveyer trippers. Section contains useful information on correct maintenance procedure. Chain Belt Co.

252—Vibrating Screens. Both dry and liquid vibrating screens are covered in 20-page catalog 2377. Descriptive material includes specific information on how to select the right screen and screen cloth; dimension tables, weights, horsepower requirements; and other valuable data. Shows variety of actual installations. Link-Belt Co.

POWER TRANSMISSION

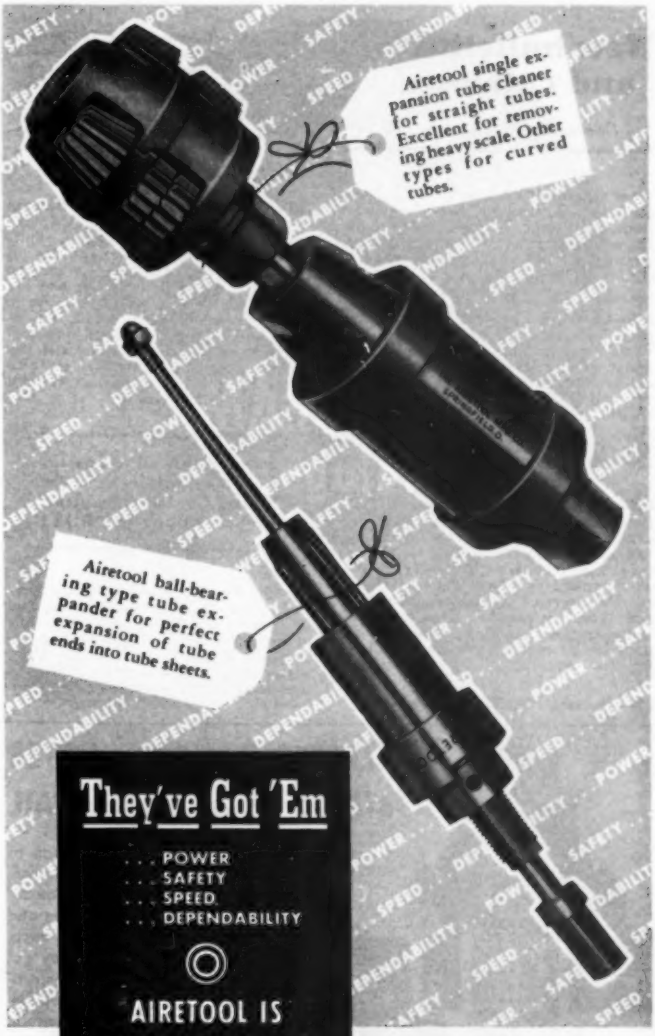
253—Speed Reducers & Gearmotors. Pocket-size, 96-page catalog gives complete engineering data on how to select the proper speed reducer to fit requirements, including horsepower ratings, ratios and installation graphs. Abart Gear & Machine Co.

254—Chain Drives. Catalog HD51 has been compiled to offer simple, quick means of determining interchangeability of various makes of roller and conveyer chains. Additional useful information is supplied that is of value in determining the proper application of chain drives as power transmission or conveying medium. Whitney Chain Co.

255—Gear-Type Couplings. Catalog 501 explains the advantages and features of gear-type coupling with fully crowned teeth. Shows how the unit may be used to solve wide range of special power transmission problems. Contains data on shaft sizes, and speed and load capacities. American Flexible Coupling Co.

PUMPS AND ACCESSORIES

256—Controlled Volume Pumps. Bulletin 151, 24 pages, should be of interest to those concerned with pumping controlled volume of liquid, in amounts from 3 milliliters per hr to 50 gpm. Gives complete details on controlled volume pumping along with description of reciprocating, positive displace-


Airetool single expansion tube cleaner for straight tubes. Excellent for removing heavy scale. Other types for curved tubes.
Airetool ball-bearing type tube expander for perfect expansion of tube ends into tube sheets.
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. . . SAFETY
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AIRETOOL IS THE FIRST NAME IN TUBE MAINTENANCE EQUIPMENT
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To reduce your down-time, keep cleaning, keep rolling with AIRETOOL. For full details, write The AIRETOOL Mfg. Co., 318 S. Center St., Springfield, Ohio.
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New bulletins and catalogs

(Continued from page 149)

ment type unit. Includes data required for selecting units for specific applications. Four pages of color charts show the relative corrosion resistance of materials of construction to over 170 chemicals. Milton Roy Co.

257—Chemical Service Pump. Four page, two color bulletin WQ213 is devoted to centrifugal pump for process and chemical plants having semi-critical requirements. Available in 1, 1¼, 1½, and 3 in. discharge sizes and heads to 240 ft. Bulletin includes specifications, dimensions and selection chart; also external and sectional views. Warren Steam Pump Co., Inc.

258—Duck & Rubber Packings. Various types of duck and rubber packings including low pressure, cross expansion, hydraulic, hollow core, round rubber core, and diagonal expansion types are all described in 8-page bulletin. Gives complete service recommendations for each type, lists standard sizes available, and gives complete packaging specifications on all types. Raybestos-Manhattan, Inc., Packing Div.

259—Packing, Packing Tools. Anti-frictional, self-lubricating, flexible metallic packing, along with flexible packing tools are illustrated and described in 4-page bulletin 436. Discusses types and styles and suggests recommended uses. Rotary mechanical seals also are covered briefly. Gives bulletin numbers for more detailed information. Duralmetallic Corp.

260—Centrifugal Sump Pump. Bulletin WQ220 covers type VS and VN centrifugal sump pumps. These units which are available in wet and dry pit types, handle clear liquids, sewage and other liquids containing solids and are made in 1½ to 8 in. sizes, capacities to 2000 gpm and heads to 120 ft. The 8-page booklet shows external and sectional views, impeller designs and has dimension and selection tables; also comments on applications. Warren Steam Pump Co., Inc.

Bulletins and catalogs reviewed here are yours for the asking. Use card inserted between pages 132 & 133

261—Jet Pump. Cycling jet pump operated by air, gas or steam pressure, said to handle any liquid that will flow through pipe lines, is described in illustrated 4-page bulletin 5030. Uses, advantages, operation, performance and specifications are discussed. Gives dimensions. Penberthy Injector Co.

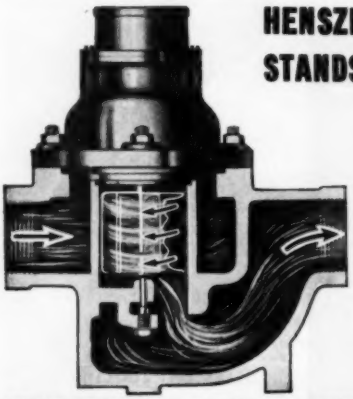
262—Rotary Pumps. Bulletin WQ50, 8 pages, illustrates and describes in detail this rotary type of pump, including both sectional and exterior views, dimensions, selection chart and specs. Warren Steam Pump Co., Inc.

263—Rotating Pump Valves. Bulletin VIII tells the whole story of inclined port rotating pump valves, adaptable to all reciprocating pumps. Said to overcome such troubles as valve slam or knock, seat-imprinting of discs, slip, valve-stem and spring breakage. The 4-page booklet gives information on valve types, materials of construction and service applications. Sectionalized photo and cross section drawing show essential features of the unit. Actual case histories show substantial dollar savings over two-year period. Sims Pump Valve Co., Inc.

TOOLS AND SPECIALTIES

264—Industrial Marking. Markers made of paint molded into convenient stick form, used for marking any type of surface—hot, cold, dry, oily or rusty—are described in illustrated folder. Gives details on eleven types and includes selection chart for choosing the correct type for specific needs. Markal Co.

265—Pipe Joint Compound. Folder describes pipe joint compound in stick form. Shows how it is used and points out advantages. Lists such applications as food and refrigeration piping. Lake Chemical Co.



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The cutting, abrasive action of hot, dirty Boiler Blowdown quickly breaks down meters that depend upon close clearances and intricate parts for their accuracy. Henszey Meters stay accurate—stay on the job—accurately measuring Boiler Blowdown, Feed Water, Condensate, Free-Running Chemicals and other "hard-to-measure" liquids. For details consult Sweet's Catalog or write:

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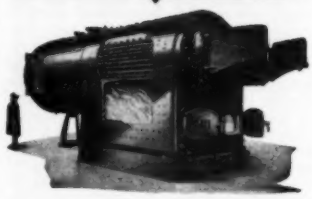

10 to 304 hp
100, 125 and 150 lbs wp

Has all the characteristics which make firebox boilers ideal for high pressure. Complies fully with ASME and SBI codes.

Outstanding for extra years of dependable service in producing hi-pressure steam economically with Oil, Gas or Coal.

WRITE Department 96-D10 for 6" scale with pipe diameter markings 640

KEWANEE BOILER CORPORATION
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266—Soldering Flux. All-purpose soldering flux in stick form is covered in illustrated folder. Explains features of the handy stick and lists industrial applications. Lake Chemical Co.

267—Tool Catalog. Complete line of over 4000 tools is illustrated and described in 104-page catalog TR. Lists all types of socket wrench equipment, hand tools and wrenches, punches, chisels, screwdrivers, pliers, tool boxes and other related tools and equipment necessary for industrial servicing operations and maintenance work. As complete specifications are included, it is easy for engineers to find exactly the tool needed to fit particular jobs. Snap-On Tools Corp.

268—Air Cylinders. Twenty-eight different models of air cylinders, each in nine bore diameters, are illustrated and described in catalog section 55. Working drawings and specifications are furnished for each model and size cylinder, both standard and cushioned types, single and double end rods, internal and external threads. Information relative to a particular model is all shown on one page, facilitating easier layout of circuits by the engineer. Rivett Lathe & Grinder, Inc.

269—Combination Hammer & Drill. Bulletin 510 on electric hammer and drill completely describes how this tool can drill concrete, masonry, metal and wood; and, cut and chip concrete along with other hammering jobs. Lists hammer tools and accessories for grinding, buffing, wire brushing, right angle drilling etc. Wodack Electric Tool Corp.

270—Cushioning Material. Simplified method for selection of right grade and weight of vibration mounting felt is described in 16-page booklet entitled "How to Reduce Vibration". American Felt Co.

271—Installation & Maintenance Tools. Tube expanders, air motors for driving them, buffing tool, polishing wheels and brushes, tube calipers, wrenches, jigs, plug pulling devices and other essential tools for the correct assembly and satisfactory operation of return bend fittings and tubes are pictured and described in 16-page bulletin 451. Includes table of expander sizes as well as chart showing recommended sizes of air motors. Key Co.

272—Arc Welder. Heavy duty a-c welder for all general welding applications is illustrated and described in 2-page bulletin M88-351. Features and advantages of the unit and regular accessories are listed as are operating data. Specs included. Miller Electric Mfg. Co.

VALVES, PIPING AND FITTINGS

273—Steam Trap Selector. Handy, 20-page bulletin T1750 lists common industrial and process equipment and shows how to select proper size trap for each type. Tables show trap capacities, factors of safety and pressure conditions. Installation recommendations also included, making this selector particularly useful for engineers who

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Pressure Reducing
Problems...
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Production and maintenance men can count on Masoneilan Pressure Reducing Valves to give accurate control of steam, water or air. Quality constructed of high grade materials they give long-lived service . . . require minimum of maintenance because they are *built up to the job* not down to price.

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Mason-Neilan Regulator Co., Ltd., Montreal and Toronto

New bulletins and catalogs

(Continued from page 151)

have many applications for steam traps. Yarnall-Waring Co.

274—Nickel Pipe & Tubing. Technical bulletin T17 contains 27 pages of information on nickel and high nickel alloy pipe and tubing. Illustrated by drawings and photographs. Presents tables on mechanical and physical properties, ASME code requirements, recommended welding procedures and other data. The International Nickel Co., Inc.

275—Safety-Relief Valves. Discharge header systems based upon the partial or complete elimination of back-pressure effects on tied-in safety-relief valves are discussed in 34-page manual 51B. Claimed to offer savings on the cost of conventional discharge piping, this manual gives operating test data on complete line of bellows-type safety-relief valves, as well as data of general interest to those concerned with closed safety-relief discharge systems. Large part of the manual is devoted to theoretical and operating data. Farris Engineering Corp.

276—Low-Pressure Couplings. Illustrated 4-page folder 514 describes low-pressure Wedge-Lock coupling designed for connecting lightweight pipe in ventilating and similar low-pressure service. Features speed and simplicity of installation, it is stated. Included in data are complete specifications on pipe sizes from 8 to 30 in. in dia. Naylor Pipe Co.

277—Steam, Air Traps. Data on steam traps and air traps are contained in 12-page condensed catalog. Lists cast semi-steel and forged steel inverted bucket traps, compound steam traps, ball float air traps, Y-type strainers and internal check valves. There are four pages of information on calculation of condensate loads and selection of traps to handle these loads. Parts list also included. Armstrong Machine Works.

Bulletins and catalogs reviewed here are yours for the asking. Use card inserted between pages 132 & 133

278—Steam, Air, Gasoline Traps. Catalog 751, 32 pages, illustrates and describes five types of thermostatic steam traps for pressures to 225 lbs; two types of expansion steam traps for pressures to 250 lbs; three types of weight-operated traps for steam, air, gasoline, pressures to 1500 lbs; also three types of steam, air and gas separators. Complete with capacity tables, installation diagrams, as well as a section containing data, charts and formulas for determining proper size trap for specific applications. W. H. Nicholson & Co.

279—Relief Valves. Bulletin W-2 contains 8 pages of information about cushioned surge relief valves. Features detailed sectional diagrams of the units and gives general and installation arrangements. Parts, materials, and dimensions are tabulated, and valve adjustment, servicing, operation, and other considerations are described and discussed. Golden Anderson Valve Specialty Co.

280—Packing Units. Packing units for Chiksan ball-bearing swivel joints are pictured and described in 4-page bulletin. Tables give joint sizes and material, and show proper packing unit for each style. Packing arrangements for the units are shown in sketches. Ordering information included. Chiksan Co.

281—Rubber-Lined Valves. Gate and check valves, lined with hard rubber, are illustrated and described in bulletin. Diagrams and cutaways show design and construction features of the different types available. Tables give sizes, dimensions, capacities, etc. Darling Valve & Mfg. Co.

282—Piping Insulation. Well illustrated 24-page booklet 37-B discusses the advantages of cellular glass insulation, listing its properties, typical data for cold, intermediate, and hot applications,

Fill up cracks, ruts, shallow holes, uneven spots, etc., in concrete floors with Smooth-On No. 7B Quick Floor Patch Cement. The patch will harden quickly, adhere strongly to an old floor, and is ready for use as soon as it is hard.

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details for insulating tanks, ducts, removable covers, and tank heads, accessory materials, and prominent users. Tables show sizes and shapes available in pipe insulation, standard blocks, beveled lags, and standard curved segments, and recommended shapes and thicknesses. Pittsburgh Corning Corp.

HEATING, VENTILATING AND AIR CONDITIONING

283—Concentrators. Niagara offers two pieces of literature—bulletins 118 and 119—describing and illustrating the no-frost method of refrigerating spaces. Explains advantages of the system and shows economical benefits. Flow diagrams along with installation photos show the units in operation. Capacities and dimensions included. Niagara Blower Co.

284—Dehumidifiers. Method of combining chemical dehumidification with mechanical refrigeration, said to obtain air of extremely low dew point at subzero temperatures, is outlined in 4-page bulletin K151. Features of the units are listed and typical installations are shown. Schematic drawing and flow charts show general and specific arrangements of the system. Kathabar Div., Surface Combustion Corp.

285—Air Conditioner. Self-contained air conditioner for spot applications is pictured and described in 4-page bulletin. One electrical and three piping connections are all that is required to install the 3, 5, or 7½ ton units, says the booklet. Features, dimensions, and operating and maintenance instructions are included. The Trane Co.

MISCELLANEOUS

286—Tank Venting Equipment. Bulletin CP2001 illustrates and describes tank venting equipment. The 32-page booklet also presents series of tank equipment, gas control and safety devices for the safe handling and conservation of combustibles or toxic liquids and gases. Sectional drawings and photographs illustrate each unit. Sizes and dimensions given in tabular form along with other engineering data. Vapor Recovery Systems Co.

287—Die Pressed Forgings. Handy reference booklet B9 provides 12 pages of illustrations to show what copper and copper alloy die pressed forgings are . . . what they can do . . . what they have already done . . . what can be expected of them. Contains tabulation of physical properties of copper and copper alloys suitable for forgings. The American Brass Co.

288—Resistance Welding of Nickel. Technical booklet T33 on resistance welding of nickel and high nickel alloys contains 32 pages, illustrated throughout by drawings and photographs. Presents tables on mechanical properties, chemical compositions, recommended conditions for welding and other information. The International Nickel Co., Inc.

289—Fire Extinguisher Guide. Two-color 12 x 22 in. poster quickly tells

Less "Elbow Grease" Needed Because

DARTS

are DROP-TIGHT!

This True Ball Joint Makes the Difference

You don't have to be a "muscle man" to tighten a Dart — they're drop-tight without excessive wrenching. That's one reason why they can be used over and over again.

Darts *last longer* because both seats are non-corrosive bronze for resilience and peak protection against corrosion and pitting. What's more, both seats are *precision machined* then *spherically ground* to a true ball joint.

Last, the nut and both ends of a Dart are *practically indestructible.* They're made from high test, air-refined malleable iron.

Because they're grief-proof in the jobs they do — Darts are grief-proof for the dealers who handle them!

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reasons you'll rate R B R compound 1st for your wire-pulling jobs

This new compound is designed specifically to give you maximum performance in pulling rubber covered, asphalt coated and other types of covered wire. Check these 7 values Albany R B R compound gives you.

1. **Inert.** R B R does not dissolve or soften rubber or other coatings.
2. **Will not separate.** Requires no mixing or stirring prior to use.
3. **Clean.** Light in color, no dirty clothes or hands. May be removed by washing with water.
4. **Permanent.** Allows easy removal of wire if necessary in later years.
5. **Non-evaporating.** Won't dry out in the can. May be taken from job to job after can is open.
6. **Less stress.** Dynamometer tests show lower stresses than with ordinary compounds.
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For speed, ease and economy, use Albany R B R compound. Available in 10 and 25 lb containers; 125 and 500 lb drums.

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Mfrs. of Albany Lubricating Products
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New bulletins and catalogs

(Continued from page 153)

the correct fire extinguisher to use on rubbish, wood, inflammable liquid or electrical type fires. Is ideal for posting at strategic locations. Randolph Laboratories, Inc.

290—Hydraulic Oils. Technical bulletin B4 (revised) is a 44-page guidebook for all who are interested in the use of hydraulic oils in industry. Contains fundamental information on hydraulic systems, maintenance, troubleshooting, and selection of proper fluids. Sun Oil Co.

291—Lubricator. Details on general purpose, force feed lubricator are presented in 12-page catalog 94-C. Discusses general construction and operation of the liquid sight feed type unit and gives explanation of various features. Two pages of dimensions and engineering data are contained. Manzel Div., Frontier Industries, Inc.

292—Stainless Steel Handbook. Complete on-the-job reference data on stainless steels is offered in completely rewritten 120-page cloth-bound volume. It discusses approximately 40 different types of stainless steel and covers each type from standpoints of analyses, fabrication, heat treatment and special conditions of service. Selector table containing about 30 types, list 40 properties. Second group of tables lists the corrosion resistance to the various media. The Allegheny Ludlum Steel Corp.

BULLETINS AND CATALOGS — ARRIVED TOO LATE TO CLASSIFY

293—Electric Heating Elements. Thin, flat, sheathed electric heating elements suitable for a variety of industrial applications are presented in 4-page catalog 91951. Discusses design and gives helpful information on selecting the proper element. Wattage information is given in tabular form. Diagrams show dimensions and terminal details along with details on bending the heater elements. Syntron Co.

294—Variable Speed Pulleys. Engineers with variable speed problems may find 30-page catalog 651 helpful. Contains complete listing, description and engineering data on line of variable speed pulleys, companion sheaves, adjustable standard and countershaft motor bases, tilting motor bases and V-belts. Includes discussions on design and construction along with operating principle. Gives data on drive selection and shows numerous installation photos. Available in 14 horsepower ratings. Gerbing Mfg. Corp.

295—Gage Valve. Forged steel gage valve with a male inlet in ¼ in. size is completely covered in bulletin 510. Features are described and applications listed. Includes full dimensions and data. Edward Valves, Inc.

296—Blow-off Valves. Up-to-date information on blow-off valves for pressures up to 400 lb is given in revised 24-page bulletin B425 (1951). Lists construction features, specifications, styles and dimensions. Numerous diagrams, tables and photographs give complete details. Valve selector table included. Yarnall-Waring Co.

297—Swing Joints. Features of joints which provide swivel or slow, continuous, rotating movement without side flexibility are illustrated and described in 4-page bulletin. Contains detailed performance data, dimensions and installation combinations. Can handle air, gas, water, oil and most chemicals according to the booklet. Barco Mfg. Co.

298—Spring Testers. New line of spring testers for both tension and compression springs are pictured and described in bulletin. Testers have capacities ranging from 200 grams to 10,000 lb. John Chatillon & Sons.

299—Control System. Photographs, line sketches, dimensional drawings and schematic diagram showing principle of operation highlight 4-page bulletin A701 that describes the Autronic System as a miniature all-electronic system for controlling pressure, temperature, flow and level. Typical applications include chemical processing plants, refineries and central stations. The Swartwout Co.

300—General Catalog. Proportioning equipment, instruments and feeders are presented in general catalog that lists 72 available bulletins. Covers complete line of standardized machines for automatic treating, feeding, diluting, blending, proportioning and sampling. Offers wide variety of instruments for metering and controlling flow, liquid level, temperature, pressure, and weight. Also gives bulletin numbers on volumetric and gravimetric feeders for dry materials and the feeding of liquids by gravity. B-I-F Industries.

301—Steam Specialties. Four types of steam traps, six kinds of controls, strainers, compressed air traps and other steam specialties are illustrated and briefly described in general catalog 2238. Sarco Co., Inc.

302—Power Plant Valve Guide. Handy, quick reference guide to cast and forged steel valves illustrates and describes only those valves applicable to power plant use. Other valves are listed, but with brief descriptions only. The pictorial content covers blow-off, instrument, non-return, cast steel check, and cast and forged steel globe and angle valves. Lists design and construction features. Edward Valves, Inc.

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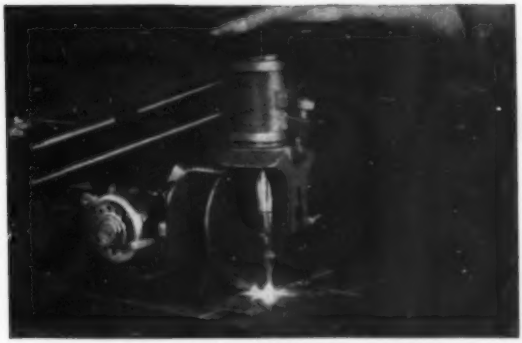
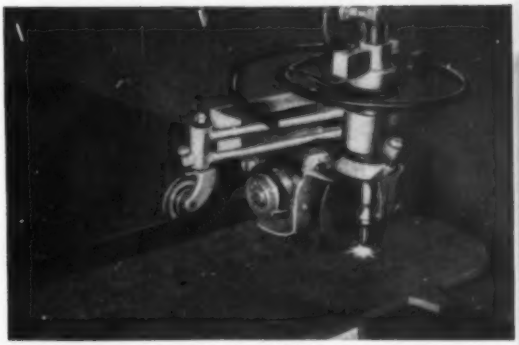
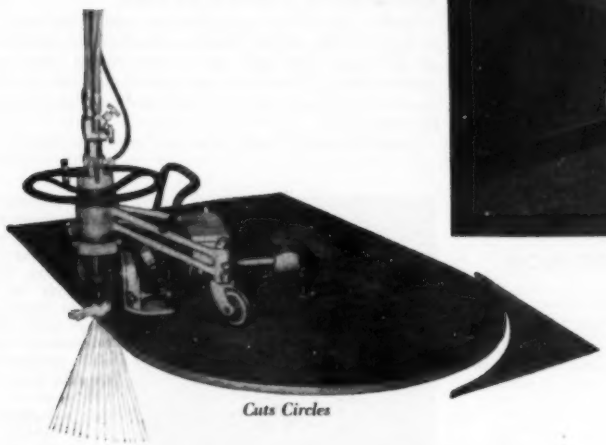


Cuts Irregular Shapes



Cuts Straight Lines



Cuts Circles

In large and small shops alike, the OXWELD CM-16 Portable Cutting Machine fills an unbelievably wide variety of oxygen cutting requirements. It cuts circles automatically. Hand-guided, it cuts irregular shapes. Operated on track, it cuts straight lines.

Indoors or out—wherever steel needs shaping—the CM-16 makes it easy to "tailor" parts as fast as the work can be laid out. *And its ready adaptability for special jobs is limited only by its operator's ingenuity!*

The CM-16 sets up as quickly as any manual outfit. It weighs only 45 lb., travels directly on the work, and is easy to carry from job to job. In normal use, it cuts up to 4 in. of steel; with standard accessories, it cuts materials up to 18 in. thick and it cuts bevels.

Any LINDE representative will be glad to show you how the OXWELD CM-16 Portable Cutting Machine can boost production and cut fabricating costs in your shop. Write for catalog, Form 4487, or call the LINDE Office nearest you today for a free demonstration.

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Cut Fuel Oil Costs Three Ways at Once!

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1. DISSOLVES SLUDGE FAST

Houghto-Solv makes the sludge in the bottom of your tank burnable—cutting down waste, eliminating messy tank and system cleaning.

2. KEEPS NEW SLUDGE FROM FORMING

Every gallon of Houghto-Solv keeps as much as 4,000 gallons of fuel oil free of sludge formation.

3. GIVES YOU MORE BTU's FOR THE MONEY

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PHILADELPHIA · CHICAGO · DETROIT · SAN FRANCISCO

Ready to give you on-the-job service . . .

Spot news

(Continued from page 114)

regularly for normal protection of parts in storage, resisted the attack of oozy mud and flood water. Thousands of metal parts, although drenched and covered with mud, came through unscathed. When cleaned, it will be impossible to tell them from "unflooded" products, according to D. M. Gilbert, parts manager, Caterpillar parts depots.

Another coating of Clear Coat will be applied in an emergency assembly-line clean-up system now being set up at the depot. All metal parts will be run through a steam cleaning operation, will be de-greased, sent through a neutralizing tank, be given the second coating of the rust-preventive compound, and re-packaged for storage and shipment direct to users and service stations.

Radiant Heaters Aid Salvage Operations at Kansas City Plant

In the wake of the recent midwest flood an instance came to light in which electric heaters proved they could take care of themselves and help get a water-logged plant going again in a hurry. Here's how the job was done when waters receded at Sealright Co., Inc., Kansas City, Kan., container manufacturers.

Four Chromalox radiant heaters normally used to dry

After Kansas City flood, these radiant heaters were rewired and dried themselves. Used regularly to dry ink on cardboard, they were taken temporarily from that service and used to oven dry 300 electric motors damaged by flood waters and submergence in mud and silt

ink on cardboard were re-wired in series and allowed to dry themselves at a low heat. They were then installed in a temporary insulated plywood oven as shown in the illustration. An electric fan was used to circulate air in the oven, making it possible to hold the temperature constant at 200 F. Then "production" began.

Operating continuously 24 hours a day, the oven dried 300 motors (75 per cent of the plant's total) and various other equipment in little more than two weeks. The radiant heaters, made by Edwin L. Wiegand Co., were then returned to their former occupation.

Two-Way Radio for Plant Protection Approved by F. C. C.

A two-way radio system to be used exclusively for plant protection will be installed at the Schenectady Works of the General Electric Co. Charles H. Muir, Jr., Schenectady Works security agent, said that the addition of this independent network, construction of which will begin immedi-

ately, will make the G-E plant one of the best protected in the country.

The network will include 35 base stations in guard posts throughout the 600 acre plant and seven mobile stations installed in plant police cars, fire trucks and ambulances. Equipment for it was manufactured at General Electric's Electronics Division in Syracuse, N. Y.

G. E. and other companies have previously used two-way radio systems for transportation dispatching and mobile police units. But the permit for the erection of base stations and mobile units, exclusively for plant protection, is believed to be one of the first issued by the Federal Communications Committee.

Canadian Firm Installs Dominion's First Centrifugal Ammonia Condensing Equipment

The first centrifugal ammonia condensing machine ever to be installed in Canada has just been ordered for a special space-conserving refrigeration expansion program in the Toronto plant of Canada Packers Ltd., it has been announced by Carrier Corp. Canada Packers Ltd., is one of the Dominion's largest meat packing companies.

This extremely compact Carrier machine will supplement existing compressors, enabling the plant to increase refrigeration capacity without the need to build additional space for installation, according to officials of Carrier's International Division. As a special feature, provision for a back pressure steam turbine drive will make it possible to use steam for plant processing purposes after it has been used in producing plant refrigeration.

The ammonia condensing unit resembles Carrier's centrifugal refrigeration machines, and consists essentially of a centrifugal compressor and matching, close-coupled condenser and cooler.

Removing the latent heat from the ammonia, causing it to condense without the need for compression, is done by the unit's freon refrigeration cycle. The ammonia gas from the plant's cold diffusers will be piped directly into the cooler, from which it will emerge as a liquid at minus 1 deg F.

Operation of the centrifugal condensing unit will be in parallel with a number of existing reciprocating compressors. It will be driven by a 1130 hp steam turbine, and will have a refrigeration capacity of 600 tons.

Today's Boilers Owe Development To Stress-Testing Of Metal At High Heat

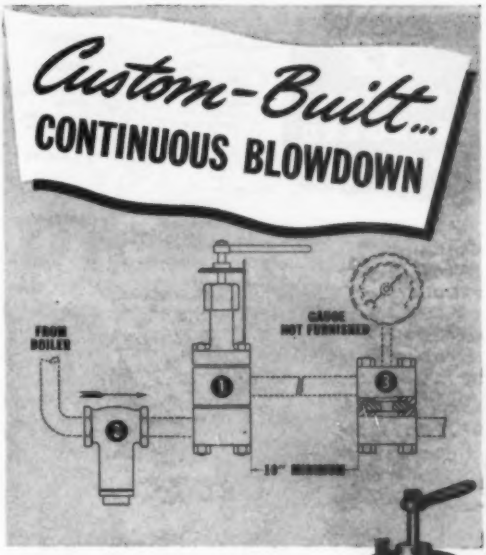
Present-day high efficiency and reliability of boilers is due largely to studies made during the past 25 years on the properties and behavior of metals under long-time exposure to stress at elevated temperatures. This was brought out in a paper presented at the last annual meeting of the ASME by John B. Romer, consultant, Research and Development Department, The Babcock and Wilcox Co., and Harold D. Newell, chief metallurgist, with the B&W Tube Co.

Today, large boiler units may range in capacity up to 1,380,000 lb of steam per hr. Superheat temperatures are crowding 1100 F at the turbine throttle with design pressure as high as 2600 psi. Process steam is produced at the even higher temperatures of 1300 to 1500 F, but at lower pressures than in boilers for power generation.

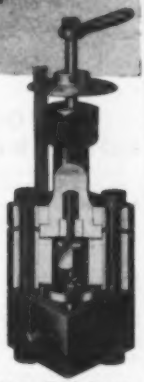
Investigations of creep and stress-rupture have led to the development of superior construction materials for the superheater and its headers and to improvements in those other parts which operate at lower temperatures, such as drums, steam and water wall tubes, economizer tubes and piping, it was pointed out.

The concept of creep in metallic materials began to attract serious attention about 30 years ago. Early tests showed

(Continued on page 158)



STRONG Dual-Orifice Assembly gives Greater Accuracy . . . Rugged Service!



Strong's Continuous Boiler Blowdown Assembly includes a Strong *block steel* Evrtyte® Valve (1), a strainer (2) and an orifice block (3), *custom-built* and accurately sized *for your own job conditions.*

The assembly is essentially two orifices arranged in series. The first orifice (valve) is variable . . . . the second is fixed. Correct proportioning of orifices provides extremely accurate control and reduces wire drawing.

Also available in outside screw and yoke.

Strong Evrtyte steel valves have special Anum-Metl X seats and discs of 750 Brinell surface hardness for long life. Available for pressures to 1500 psi and temperatures to 800° F. or 6000 psi non-shock cold service.

Let us custom-size your continuous blowdown system. Send for Catalog No. 68-J and our Continuous Blowdown Check-Chart today!

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FOILED AGAIN!
Those three little villains — Dust, Dirt, and Grit — are foiled every time they match their wits against a CLEMENTS-CADILLAC blower-suction cleaner. It blasts them out of every nook and cranny of your machinery and equipment—quickly, easily, and economically.
Eligible under C.M.P. regulations.
MACHINERY
MOTORS
STOCK BINS
REFUSE
SAVE
TIME - MONEY
PREVENT DAMAGE
TO MACHINERY
WITH THE . . .
Made in 5 models
with attachments for
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CLEMENTS MFG. CO.
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ASK YOUR MILL SUPPLY DEALER OR WRITE US FOR DATA

Spot news

(Continued from page 157)

that rupture of a metallic material could occur when it is subjected to a stress at elevated temperatures for a sufficiently long time, even though the stress applied was considerably lower than that necessary to cause fracture in the short-time tensile test at the same temperature.

Present practice in B&W's creep laboratory is to run both creep and stress-rupture tests on a material to 10,000 hr or longer at temperatures throughout its use range. Since boiler superheaters are generally expected to last more than 100,000 hr, this test period of at least 10 per cent of the service life is preferred. Long-time tests will usually indicate the beginning of the third creep stage which ultimately leads to rupture.

Stress-rupture tests are conducted to estimate the stress required for fracturing the metal under prolonged loading. They are made by loading the specimens with stresses which will cause rupture of the specimens in time periods ranging from 100 to 10,000 hr or more. Longer-time rupture tests than 1000 hr are preferred in boiler work and over a range of stresses extending downward to those tending to bridge the gap between the creep test and the rupture tests.

Metals vary in high temperature strength and ductility under stress to a great extent as influenced by a number of factors. Composition, manufacturing history and deoxidation, grain size and structural condition all impose their effects. At a fast rate a metal may extend appreciably, whereas with slow rates and longer fracture times, it may suffer intergranular fracture with little or no apparent deformation. The stiffer and more creep resistant the metal is the more is this character in evidence, the authors said.

Record Conveyer Lift Brings Ore From Three Miles At Sea

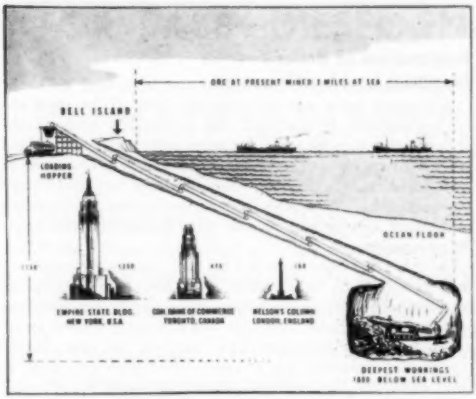
Surpassing a previous world's record for a lift of 862 ft, the 1,730 ft high, record-breaking lift belt system will be installed by Goodyear-Canada and co-designer Stephens-Adamson Manufacturing Co. of Canada, in the Wabana

WESTINGHOUSE ENGINEERS TEST FAN BEFORE SHIPMENT

Research engineers of the Westinghouse Sturtevant Division, Boston, test induced draft fan destined for installation in an Italian power station. Fan will handle 1,240,000 lb of 300 F flue gas each day. To do this, the 5½ ft diameter wheel, driven by a 600 hp motor, will operate at 975 rpm

iron mine of Dominion Steel & Coal Corp., Ltd., on Bell Island, Newfoundland.

The mine has been in operation for 50 years. In the beginning ore was loaded by hand. Later mechanical equipment was used and transport was by electric locomotives.


ORE AT PRESENT MINED 3 MILES AT SEA
BELL ISLAND
LOADING HOPPER
OCEAN FLOOR
EMPIRE STATE BLDG. NEW YORK, U.S.A.
CDN. BANK OF COMMERCE TORONTO, CANADA
BELLON'S COLUMN LONDON, ENGLAND
DEEPEST WORKINGS 1000 BELOW SEA LEVEL

Iron ore mine 1730 ft below sea level now has conveyor to deliver 1000 tons per hr up 12,500 ft slope

The complete lift belt system, which features compass rope belts, will deliver 1,000 ton per hr up a slope 12,500 ft long. It will consist of two flights 1,450 ft long and eight flights 1,230 ft long. The belting will be 36 in. wide.

Pumping Station Uses Cathodic Protection To Eliminate Corrosion in Underground Lines

The Harco Corp. recently announced the installation of a specially engineered cathodic protective system in a midwestern natural gas pumping station. Natural gas is received by the station through large diameter lines at approximately 400 psi. In the compression station, this natural gas is boosted to a 700 psi pressure and piped north and east for subsequent use in both domestical and industrial applications.

More than 45,000 sq ft of metal pipe surface is located underground in this pressure boosting station to carry the gas to and from the compressors and water to the cooling towers. Estimated cost of this piping installation is more than $750,000. Soil conditions in this area are such that unprotected metallic pipe lasts on an average of from 9 to 11 years.

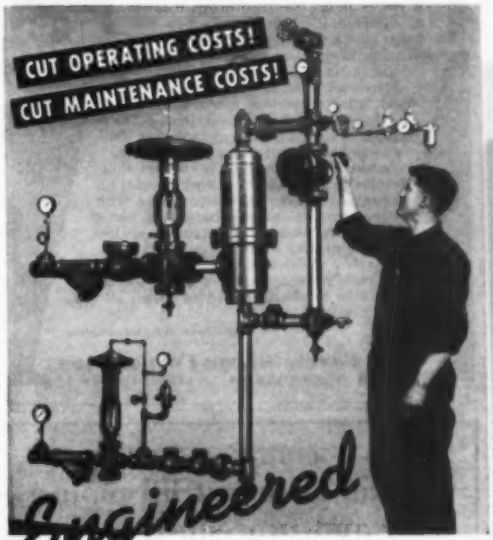
With the cathodic protection system installed, the corrosion factor of the underground piping in this station has been virtually eliminated, and protection to the piping approaches 100 per cent. Total cost of the installation was less than $15,000.

In order to provide maximum protection for the piping, Harco engineers took into consideration such factors as soil conductivity, moisture content, soil and water chemical characteristics, temperatures and dissimilar metals. Three electrode beds utilizing a total of 80 National Carbon graphite anodes were prepared, and National Carbon type BF-3 backfill material was specified. General Electric rectifiers delivering an estimated power output of 130 amp were installed. Direct current impressed on the anodes radiates through the backfill material and soil to the metal pipe surface to prevent electro-chemical action which corrodes metals.

(Continued on page 160)

THE SURE WAY TO
CUT HOT WATER
Costs!

Pick INSTANTANEOUS WATER HEATERS



TO PROVIDE
ANY VOLUME OF WATER
AT THE TEMPERATURE REQUIRED!

Here's the money-saving answer to hot water required for industrial needs. PICK Heaters provide hot water *instantly* — by steam injection. They're entirely automatic to provide and accurately maintain temperatures up to 180° F. The exclusive Pressurizer Piston stabilizes injection pressure — eliminates pipe hammering and shaking. Available in seven sizes with rated capacities of 10 to 200 gallons per minute. Greater volumes can be obtained by multiple installations. Installation is simple, requiring only ordinary pipe connections.

NO STORAGE TANKS NEEDED
Compact design permits installation in corners, on walls or overhead.

EASILY CLEANED
No coils. Can be cleaned in a matter of minutes — without dismantling.

Proved
BY PERFORMANCE IN
FACTORIES • HOSPITALS
LAUNDRIES • BREWERIES
DAIRIES • TANNERIES
CANNERIES

Write for Engineering Details and Specifications Write Dept. IPS

MANUFACTURED BY
PICK MANUFACTURING CO.
WEST BEND, WISCONSIN, U.S.A.

SELF -CONTAINED -CONTROLLED -SUFFICIENT -RELIANT

Stacon Temperature Regulator*

The patented Farris Stacon Temperature Regulator is easily the most independent regulator available today. It's unique. It stands alone. It's trustworthy. It needs no watching. It's perfect for the man who wants no cause for worry . . . who wants to relax in the sure knowledge that his temperatures are constant.

Here's why Stacon stands alone in the field. It has no packing glands to leak or bind . . . the stem moves freely. The liquid in the bulb flashes to vapor in the power bellows, assuring hairtrigger response to move the disc. It operates with unbelievable accuracy—to within plus or minus 1 degree—and it operates with that accuracy under *all* conditions. Stacon provides air-operated accuracy at low, self-operated cost.

Get the details on the one truly outstanding temperature regulator—Stacon. Send for Bulletin 50-1000 to get all the details.

*Patented and Patents Pending

Farris Stacon Corporation
533 COMMERCIAL AVE. PALISADES PARK, N. J.

Now – a complete, accurate manual of industrial piping data and procedures

HERE is a practical guide for designers, estimators, foremen, engineers, etc. This book gives piping principles, methods, and know how to aid in the design and use of pipe, fittings, and materials for industrial purposes. Packed into its pages is a vast amount of useful data on the materials and types of piping required in the chemical, process, and petroleum industries — all the most frequently-needed standards, practices, and data which are of value to the practical piping man.

Just Out

INDUSTRIAL PIPING

By Charles T. Littleton
Formerly Engineer in Charge of Piping, American Cyanamid Co.

394 pages, illus., $8.00

THIS book covers steam, water, oil, gas, and instrument piping, giving useful methods of flow calculations. For each specific service, it tells which pipe materials, fittings, and valves should be used —shows their advantages and disadvantages, and explains the methods for installing them. Covers the Fanning Formula to solve oil-flow problems; gas laws; the types of insulation recommended for pipe at different temperatures; etc.

Gives practical helps and information such as this:

- 12 rules for safe handling of oxygen
- 5 types of joints used in water piping
- the use of jacketed pipe and fittings
- instrument air header piping
- installation, operation, and maintenance of valves
- alloys and plastics used in industrial piping
- hard rubber pipe and fittings
- piping cost estimation
- etc.

ORDER FROM
INDUSTRY AND POWER
Reader's Service Dept. St. Joseph, Michigan

Spot news *(Continued from page 159)*

Restoration of Boiler Numbers Lost by Corrosion

Corrosion has a way of affecting metal in the most annoying manner, at any time, but particularly when it obliterates the identification numbers on a boiler shell. This occurred recently on the boiler of a crane. It was known to have identification on it but this could not be proved since it was illegible. Without proper identification the licensing authorities were unable to start their inspection prior to issuing a license.

At this point Sam Tour & Co., Inc., consulting engineers and metallurgists, were called upon. The boiler insulation was removed from around the area at which the numbers were thought to exist. This area was cleaned and then given an acid etching treatment. The numbers became clearly legible and disclosed that the boiler had been inspected in three different years, that it carried a National Board serial number; also, an American Society of Mechanical Engineers number.

This information satisfied the inspection and insurance authorities and a license was granted.

Window Cleaning Now Done Easily With Wire Brushes

Osborn Manufacturing Co. solves the problem of cleaning dirty windows in factories with wire brushes mounted on portable tools operating at 3450 rpm or more. The wire brushes prove more effective than detergents, acids or soap and water and, at the same time, eliminate much of the messiness.

Operating on a disc center section, 6 in. in diameter with 0.016 in. wire fill, down to small ringlock sections $1\frac{1}{2}$ in. in diameter, the brushes can be used depending on the type of window frame.

With a minimum of work and cost, windows can now be cleaned of grit and grime, increasing workers' morale and savings in electricity.

HIGH PRESSURE BOILER FEED PUMPS FOR UTILITY

Two De Laval feedwater pumps were recently shipped to the new 60,000 kw Danskammer Station of the Central Hudson Gas & Electric Co. Pumps are 11 stage 2040 psi units driven by 2000 hp motors through American Blower Co. fluid drives. Operation conditions at the plant will be 1650 psi, 1000 F

CLASSIFIED ADVERTISING

FOR SALE—DIESEL ENGINES

One Enterprise Model DSQ-6, 16 x 20 Diesel Engine. 797 HP. 327 RPM. Direct connected to Elliott AC Generator 800 Kw 50° C. rise continuous. 2400 volts, 3 phase, 60 cycle, with all necessary switch gear and Maxim steam generating silencer. Used 14,275 hours.

One Enterprise Model DSQ-8, 16 x 20 Diesel Engine. 1075 HP, 327 RPM. Direct connected to Elliott AC Generator 1000 KVA, 800 Kw, 2400 Volt, 3 phase, 60 cycle, with all necessary switch gear and Maxim steam generating silencer. Used 17,423 hours.

One Fairbanks-Morse Model 32 - E - 14 x 17 Diesel Engine. 300 HP, 300 RPM. Direct connected to Generator, type TGZ-6, 250 KVA, 3 phase, 60 cycle, with all necessary switch gear and silencer. Used 27,000 hours.

NYLEN PRODUCTS COMPANY
St. Joseph, Michigan

PROFESSIONAL SERVICES

LP-GAS EQUIPMENT & CONTRACTING

INDUSTRIAL STAND-BY PLANTS OUR SPECIALTY

More than 70 Peacock Plants prove . . .
"There's No Substitute For Experience"
Write For Full Information

PAUL E. PEACOCK, JR.
Box 268, Westfield, N. J. Westfield 2-6258

FOR SALE

2 DIESEL ENGINES—Both are Fairbanks-Morse Company diesel engines equipped with alternators and exciters for generating electric current. One is 2 cylinder style VA-100 HP - 257 RPM with Type D alternator - 75 KVA. The other is one cylinder same style but 50 HP - 40 KVA. Fuel systems of both engines have been modernized. Both are 230 volt, 3 phase, 60 cycles. Further details and prices on application.

MAURER-NEUER CORPORATION
Arkansas City, Kans.

AVAILABLE REPRINTS

SPECIAL REPRINT
of the report on
INDUSTRIAL WASTE TREATMENT

To fill requests we've received for additional copies of the special report on "Industrial Waste Treatment", June 1951 issue, it has been necessary for us to re-order reprinted copies. These copies are still being offered to our readers ***free of charge in quantities of 1 to 5.*** However it is necessary for us to make a small charge, sufficient only to defray printing costs, for larger quantities. These prices are: 6 to 25 copies—25¢ each; 26 to 50 copies —20¢ each; more than 50 copies—15¢ each. Order directly from Reader Service Department, INDUSTRY AND POWER, 420 Main Street, St. Joseph, Michigan.

We also have copies of the following article reprints which are available to you free of charge:

"Boiler Houses Are Not Necessary Evils", February, 1950

"Caribou Diesel Plant Built In A Hurry", February, 1950

"Correct Plans Consider Future Expansion Too", December, 1950

"Filters . . . What They Are, How and Why They Are Applied", February, 1951

"Grievances Can Be Avoided", April, 1950

"Harbor Plant Pioneers in Pneumatic Build-Up Refractory", December, 1950

"How To Select the Correct Steam Trap", January, 1950

"How To Select Corrugated Expansion Joints", June, 1950

"Know Your Fuses", March, 1951

"Low Cost Auxiliary Power From Turbine Drives", April, 1950

"Proper Water Tower Means Water Conservation", March and April, 1951

"Qualifications Of An Industrial Supervisor", June, 1949

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"Signode Plant 'Pressurized' to Eliminate Cold Drafts", November, 1949

"Simplify Determinations Of Pipeline Pressure Losses", November, 1949

"Steam, Air and Power For 3 New Ford Assembly Plants", May, 1949

"Streamlined Steam Plant Insulation", May, 1951

"Supervisor's Personal Check-Up Chart", November, 1949

"Synchronous Motors Do Two Jobs At One Time", February, 1950

"Television . . . The Eyes Of Industrial Control", December, 1950

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"Trigonometric Calculations—I and II", April, 1951

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HOW HUNGERFORD & TERRY TREATS INDUSTRIAL WASTE WATER PROBLEMS

1. Survey of flow rates, quantity of water, available equipment, space, pipe sizes, and other information.
2. Analysis of representative waste water samples, to determine the most efficient and economical treatment. A complete report on treatment and treatment cost is submitted.
3. Build model waste water treating unit from our laboratory findings. A quantity of waste water is passed through the model in the presence of plant representatives. Samples are analyzed to show treatment process.
4. A formal proposal is prepared and submitted with a schematic drawing to show operating arrangement and complete guarantees of EFFLUENT capacity and quality.
5. Work in close co-operation with all national, state and local government authorities.

Write For More Information

HUNGERFORD & TERRY INC.
Clayton 1, New Jersey

"LIQUIDS WORTH STORING ARE WORTH MEASURING"

with a

LIQUIDOMETER

Tank Gauge

- FOR GAUGING LIQUIDS OF ALL KINDS
- 100% AUTOMATIC
- APPROVED BY UNDERWRITERS' LABORATORIES

THE **LIQUIDOMETER** CORP.
36-32 SKILLMAN AVE., LONG ISLAND CITY 1, N.Y.

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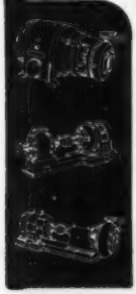
APCO *Packaged* CONDENSATION RETURN UNITS

for the SMALL LOW PRESSURE JOBS

10 to 40 lbs. with 8, 15, 30 Gallon Receivers

Packaged Duplex Condensation Return Unit with No. 4 Series Apco Pumps.



Start saving valuable heat units with APCO Square Tank Units. Built to meet demand for a smaller unit with the superb performance of our larger units. Remember, the Pumps are Apcos. No Vapor Binding — Special Provision for Expansion and Contraction — No Frictional Wear within pump. Thus, ECONOMY.

Write for Bulletin 113-ST

DISTRIBUTORS IN PRINCIPAL CITIES

AURORA Always PUMPS

AURORA PUMP COMPANY

42 Loucks Street, Aurora, Illinois

Restore Broken Floors . . . F-A-S-T!

CONCRETE PATCH

SETS INSTANTLY!

TAMP SMOOTH! TRUCK OVER!

No traffic tie-ups! Simply shovel INSTANT-USE into hole—tamp and run traffic over immediately. Quick! Durable! Repair cracks and breaks in concrete floors . . . or make complete overlays. NOTE: Plasticizer makes INSTANT-USE easy to scoop out of container . . . easy to level, to tamp, to use! There's a Flexrock material for every floor condition—oil, acid, wet, dry! Tell us your problems!

MAIL COUPON for TRIAL OFFER and HAND BOOK OF BUILDING MAINTENANCE

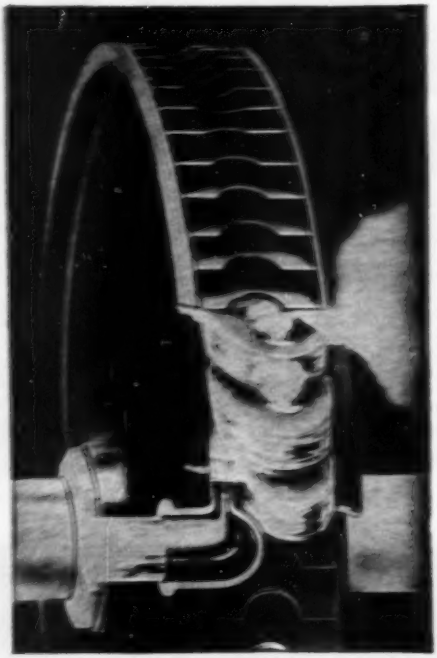
INSTANT-USE

FLEXROCK COMPANY
3405 Filbert St., Philadelphia 4, Pa.
Offices in principal cities

Please send me complete INSTANT-USE information, details of TRIAL ORDER PLAN and HAND BOOK OF BUILDING MAINTENANCE—no obligation. (Clip and attach Coupon to Co. letterhead).

Name .....
Company .....
Address .....

TERRY



Action of steam in Terry wheel turbine. The steam issues from an expanding nozzle at high velocity and enters the side of the wheel bucket at which its direction is reversed 180°. As this single reversal uses but a portion of the available energy, the steam is caught in a stationary reversing chamber and returned again to the wheel. This process is repeated several times until practically all of the useful energy has been utilized.

NO PARTS TO LOOSEN OR WORK OUT

The rotor of the Terry Wheel Turbine is a single forging of special composition steel, in which a series of semi-circular buckets is milled. There are no separate parts to become loose or work out.

The power-producing action of the steam takes place on the solid curved backs of these buckets or pockets. Therefore close clearance is unnecessary and wear on the blades forming the pockets is of little consequence, as it does not materially affect horsepower or efficiency.

For detailed information about this effective construction and its advantages, write us on your business letterhead for a copy of Terry Turbine Bulletin S-116.

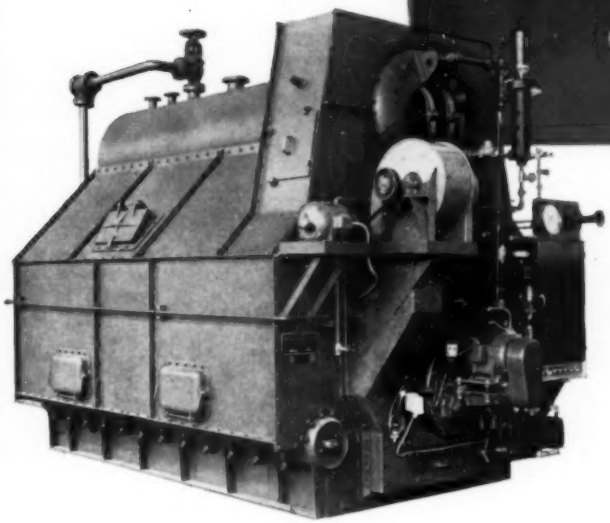
T-4172

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

WICKES

shop assembled power

FOR YOUR STEAM GENERATING NEEDS



Steam power in a compact, efficient shop-assembled unit, custom-engineered to your exact steam generating requirements, ready for immediate installation! Wickes Type A Steam Generator is a steel-encased unit complete with baffles, refractories, pressure parts and firing equipment, designed to conserve headroom and floor space. Each furnace wall is a separate steam generator as well as an integral part of the boiler. There are no complicated headers or circulating tubes to require frequent maintenance or repair. Wickes Type A shop-assembled boilers are engineered for pressures up to 900 psi. with sustained steam production up to 35,000 lbs. per hour at 20 to 330 nominal h.p.

Wickes can also fill your requirements for steam generators up to 250,000 lbs. per hour and 950 psi. — all types of multiple drum boilers adaptable to any standard method of firing, oil, gas, single retort underfeed or spreader stoker. Write today for descriptive literature on Wickes complete line of steam generating equipment or consult your nearest Wickes representative.

WICKES

THE WICKES BOILER COMPANY

DIVISION OF THE WICKES CORPORATION

SAGINAW, MICHIGAN

135

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St. Joseph, Michigan

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Permit No. 27

there's nothing wrong with this unit heater that a SUPER-SILVERTOP CAN'T CURE

Many unit heater inefficiencies are blamed on the unit itself when the real trouble lies in the trapping. Super-Silvertop Steam Traps put heat back in your unit heater. The heat delivery or B.T.U. output of your unit heaters depends, among other things, on how completely the steam compartment or core is filled with dry hot steam. Also, the faster the unit heater is brought up to temperature, the sooner it begins to operate at a maximum efficiency. By venting air and draining condensate rapidly, Super-Silvertops permit the core to be completely filled with hot dry steam. Super-Silvertops work when other traps fail because they're activated by water only regardless of temperature. Presence of water, hot or cold, causes the trap to discharge. Be prepared for winter, equip your unit heaters with Super-Silvertop Steam Traps now. See your nearest representative or distributor, or write us direct.

USE STRAIGHT-IN-LINE OR AS AN ELBOW

HOW TO SELECT STEAM TRAPS FOR UNIT HEATERS

Anderson's booklet, "Solving Steam Trap Problems" tells engineers and contractors how to select proper sized steam traps for unit heaters of various capacities. Write for your free copy today.

THE V. D. ANDERSON COMPANY

SUPER-SILVERTOP STEAM TRAPS